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POWER PLANT FOR RAILROAD LOCOMOTIVE SHOP

Distinctive Features in the Development for the Power Plant of the Main Locomotive Shops of the Chicago & Northwestern R. R.

IF YOU HAD BEEN a sight-seer in Chicago some 30 yr. ago, accompanying a friend mechanically inclined, very likely you would have been taken to see "the big shop," as it was then called, of the Chicago & Northwestern R. R. at 42nd Ave. and Kinzie St., and your friend would have felt proud to show you the 8th wonder of the world; a shop 550 ft. long, all under one roof. At that time, immense concentrated industrial shops were of rare occurrence, especially those built in the peculiar style of the railway locomotive shop, which stretched out, under one roof, in a long, low, narrow building, having the locomotive repair pits on one side and the machine floor on the other. At that time, also, individual electrical drive for machinery was not possible. A main shaft extended the entire length of the machine floor, with the power unit, belt-connected at the center. In the C. & N. W. "big shop," a 280-hp. engine was furnishing the necessary power at the time of its displacement by electric motor drive.

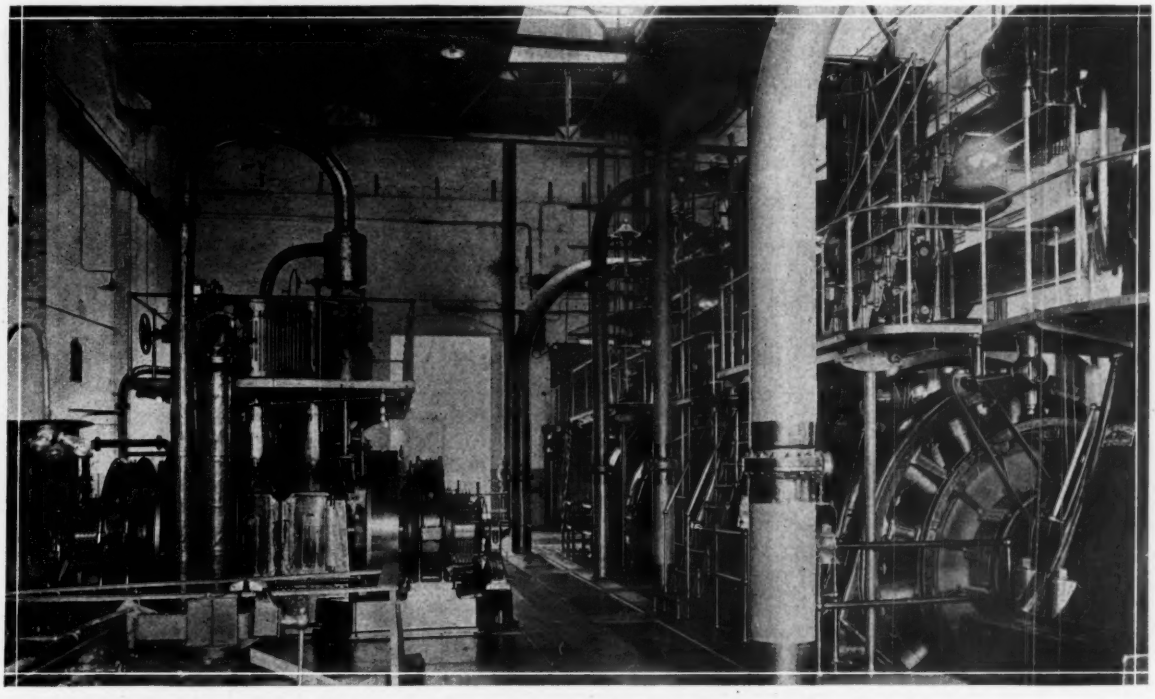


FIG. 1. ENGINE ROOM SHOWING MAIN POWER UNITS

The present day consolidation policy gradually affected affairs at the railroad shops. Instead of having a number of completely equipped machine shops all over the system, one main plant developed, the others

becoming of less importance. At the C. & N. W. R. R. big shops, the power plant required frequent changing and additions without any interruption in the delivery of power.

The first step in electric drive for the shops, was one motor belt-connected to every shaft driving 10 to 15 machines. The power plant at that time consisted of: 1 65-hp. Erie Ball simple steam engine

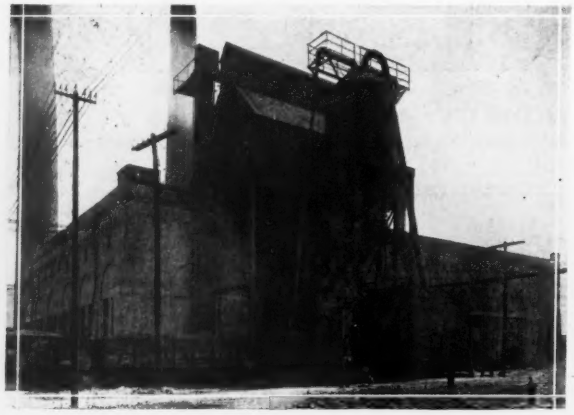


FIG. 2. GENERAL VIEW OF PLANT WITH COAL AND ASH HANDLING EQUIPMENT

direct connected to 2 20-kw. General Electric a.c. generators; 2 250-hp. Erie Ball compound engines direct connected to 2 General Electric 75-kw. d.c. generators, and necessary compressed air was furnished by a 1500-cu. ft. capacity Riedler air compressor. Steam was furnished by 6 250-hp. Babcock & Wilcox water-tube boilers.

This plant was up to rated capacity in a short time and a 500-kw. generator was added, also 2 more boilers like the first 6. But the power requirements soon exceeded the plant capacity and another 500-kw. generator was added. The air supply then became insufficient, necessitating the installation of a 2450-cu. ft. capacity air compressor. This last addition required changes in the boiler capacity, hence, the boiler room was enlarged, 4 more boilers added, another chimney built and an entirely different system of coal and ash handling equipment installed.

At the present time, the power plant occupies a building 170 ft. long by 112 ft. wide and will permit considerable increase in power developed before any further additions are necessary to the building.

Boiler Room

STEAM for the power plant and various other requirements about the shops, is furnished by 12 250-hp. Babcock & Wilcox water-tube boilers, carrying a working pressure of 135 lb.; containing 126 4-in. water tubes 18 ft. long, with 36-in. double drums and a grate area of 58 sq. ft.

The boilers are arranged in 2 rows with a 25 ft. 6 in. wide firing lane between. The inner row is comprised of 4 separate batteries of 2 boilers each. The remaining 4 boilers, in 2 separate batteries, constitute the outer row; allowing sufficient space for an additional 4 units of like capacity. The batteries are separated from each other by a 4-ft. alley, providing room for necessary piping and affording opportunity for the inspection of the furnace fires, through peep-holes in the setting.

The boilers are provided with Green chain grate stokers, driven by 2 Wachs engines; an 8-hp. for the inner row and a 6-hp. for the outer. The 2 driving shafts, belt connected to the engines, are placed in the basement one for each row of boilers. Should either engine break down, emergency drive is provided for by a cross belt connecting the 2 shafts. Under

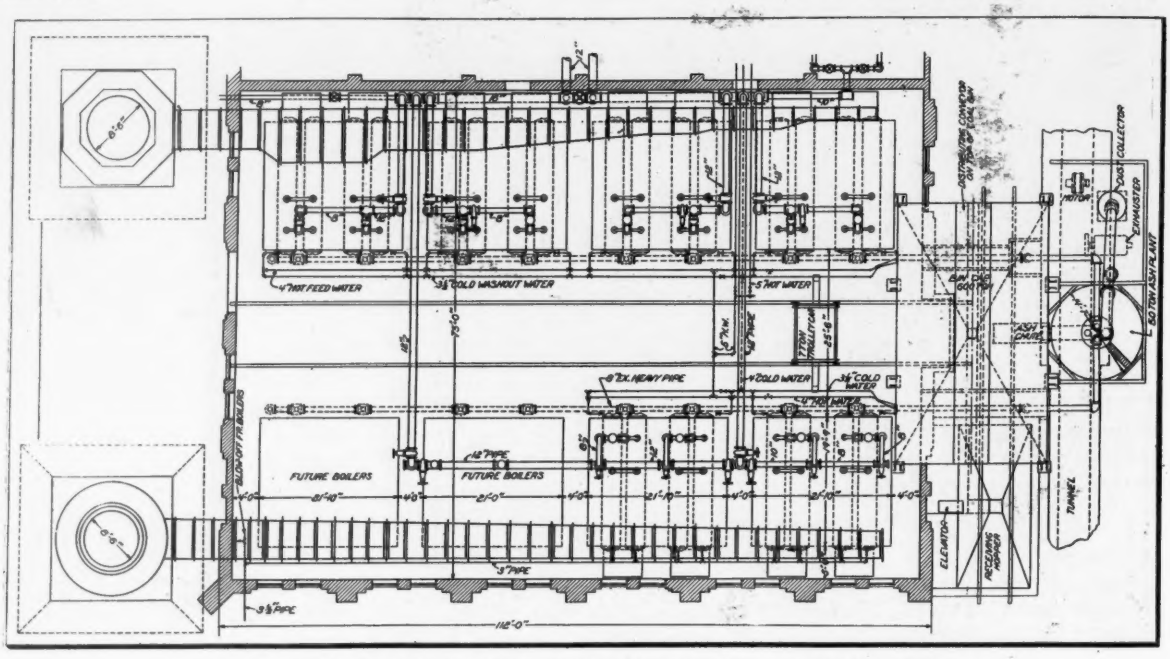


FIG. 3. PLAN OF BOILER ROOM WITH PIPING AND ASH HANDLING SYSTEM

normal conditions, this belt is loose from the pulleys but when required, can be readily put on, one engine then operating both rows of stokers. A duplicate of the belt connecting engine and shaft is conveniently

suspended, so that, should the former break, operation of the stokers will not be interfered with, except for the short time required to put on the duplicate.

Each boiler is equipped with 2 4-in. Ashton pop valves, one standard safety water column, a Babcock & Wilcox steam gage and 2 2½-in. asbestos plug cocks, followed by angle valves. Vulcan soot blowers are on each boiler and are operated once every 8 hr.

Flue gases are conducted by a common breeching for each row of boilers, to separate chimneys at one end of the building. The original stack, is 8 ft. 6 in. diameter at the top and 185 ft. high. When the plant outgrew this, a new one 200 ft. high, by 8 ft. 6 in. diameter was built to take care of the additional boiler equipment.

Coal is distributed to the stokers by a 7-ton, double-outlet, electric trolley hopper, which runs overhead in the firing lane, and is operated about once every hour. By keeping a record of the number of trips made, the fuel consumption of the plant can be obtained. Should the hopper be out of commission, coal can be dumped from the storage bin onto the firing floor and distributed to the stokers by wheelbarrows.

A reserve storage pile is provided for on an open plot of ground directly opposite the storage bunker, to which coal can be transferred from the cars by means of a clamshell crane, also used to transfer the coal from the pile to the receiving hopper, when necessary. Should the power driven conveyors be out of commission, hand wheeling can be resorted to in transferring the fuel to the firing floor. Ashes from the furnaces drop into hoppers directly underneath, and can then be raked into the conveyor pipe openings of a Geco, pneumatic, ash handling system, provided with 2 8-in. exhauster pipes, one for each row of boilers, leading into a 50-ton capacity separating tank. The dust and gases, after separating from the ashes, are drawn through an 18-in. galvanized iron pipe to the collector cylinder in the blower house, where the dust is settled while the gases are expelled to the atmosphere by a Green positive blower. The ashes in the separating tank can be dumped into railroad cars, through a gravity chute.

The system is operated 4 times a day for about an hour each time. In case of emergency, the ashes can be collected in buckets, raised to the firing floor and removed.

FIG. 4. BOILER ROOM SHOWING SOOT BLOWER PIPING AND 7-TON TROLLEY HOPPER

The draft is hand regulated at each boiler. The Heine system of horizontal baffling is used on the boilers and materially assists in their economical operation and smokeless combustion.

Coal and Ash Equipment

BITUMINOUS coal screenings, taken from the railroad company's mine at Ellespie and Benld, Ill., are used by the power plant, the locomotives being provided with the lump coal. Dump cars, run alongside of the power house, deposit their load into a receiving hopper, having an Orton and Steinbrenner coal crusher at the bottom opening, from which the coal passes to an elevator system which raises it to the top of a 600-ton coal bunker, on the outside of the boiler room.

Engine Room Equipment

THE day power equipment consists of 2 Allis-Chalmers 22 by 36 by 42-in. noncondensing, vertical, crosscompound Corliss engines; one direct connected to a General Electric 500-kw. 230-volt, 90-r.p.m., d.c. generator, the other direct connected to a similar generator made by the Westinghouse Electric & Mfg. Co.

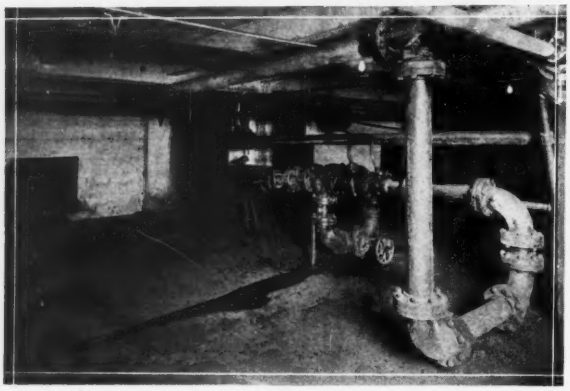


FIG 5. BOILER ROOM BASEMENT WITH VENTURI NOZZLE AND ASH EXHAUSTER PIPE

Lighting for the entire shops is run on a 115-volt, 3-wire system; the motors on 230-volts. To provide for the lighting requirements during the day load, when the 500-kw. units are supplying power, a Westinghouse 12.5-kw., 1100-r.p.m. compensator is connected to the 230-volt line.

Compressed air is supplied to the shops by 2 compressors; one a 16 by 27 by 36-in. Riedler, of 1500 cu. ft. capacity, driven by a Fraser & Chalmers 16 by 27 by 36-in. horizontal cross compound engine, 65 r.p.m., governed by a speed and air governor, and used for constant service, the other is a 2450 cu. ft., 18 by 30 by 30-in. Sullivan straight line air compressor driven by a 20 by 34 by 30-in. tandem compound steam end and is used during the operation of the main shops.

A 7-ton, overhead, hand, trolley crane, spanning the width and running the entire length of the engine room, facilitates the erection and repair of machinery.

Boiler feed water is supplied by 2 Smith-Vaile, 14 by 10 by 15-in. vertical, duplex steam pumps, governed by Northern Equipment Co. pressure governors. A 12 by 18½ by 2¼ by 10-in. Deane, duplex, compound, pot-valve pump furnishes the 1600 lb. hydraulic pressure, required in the various hydraulic presses and riveting machines used in the shops. The hydraulic accumulator is 1000 ft. distant from the power plant.

General water service requirements are cared for by 2 10 by 16 by 10 by 12-in. Fairbanks, Morse & Co. duplex, compound, steam, plunger pumps which are governed by 3½-in. Fisher regulators, suitably bypassed, so that the low pressure ordinarily carried, can be increased for fire purposes, without the governor becoming operative to shut off the steam supply.

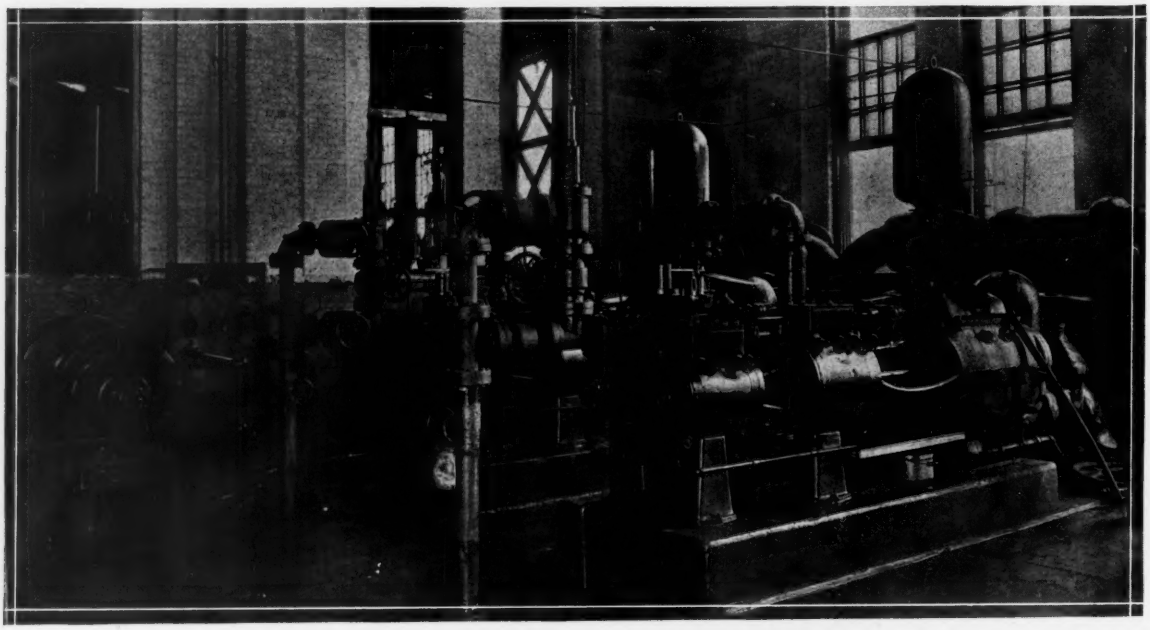


FIG. 6. SERVICE PUMPS AND 60-KW. ROTARY CONVERTER

For night power, or when the main shops are shut down, smaller units are resorted to. These are 13 by 22 by 14-in. vertical, compound Ball engines, 270 r.p.m., direct connected to a 75-kw., 125-volt, d.c. generator on each end of the shaft.

To supply current for lighting purposes for the surrounding freight yards, a 60-kw., 1100-volt, 600-r.p.m. rotary converter is used, consisting of a Sprague Electric motor direct connected to a single-phase Warren dynamo. A transformer steps down the voltage from 1100 to 400, to supply current for an electric welding device in the machine shop.

A 10 by 16 by 10 by 18-in. Fairbanks, Morse & Co. duplex, compound plunger pump is available for power plant emergency or fire service. Its discharge is piped so that it can be used to supply water for washout purposes, or in case of fire or emergency, can be connected up on the general service pipe line and act in conjunction with the service pumps.

All the water for the various purposes, such as boiler feed, washout and general service, is taken direct from the city main. A storage reservoir of 1,500,000 gal. capacity provides for a constant and uninterrupted supply of water, even though the city mains may be temporarily shut off. All service outlets are shut off in case of fire, so that an abundant supply and sufficient pressure can be maintained.

All engines and air compressors are lubricated by a forced system from an overhead storage tank of 150 gal. capacity, 40 ft. above the engine room floor, which furnishes the necessary pressure head. The oil is forced into the tank by 2 Worthington 3 by 2 by 3-in. duplex steam pumps, provided with brass plungers, one of the pumps being kept in reserve for emergency or repair. The suction of the pumps is taken from 2 500-gal. oil filters into which the return oil of the system flows.

A Webster vacuum heating system is installed throughout the shops, using exhaust steam of the plant for the purpose, with a 14 by 18 by 20-in. Marsh, simplex steam pump to handle the return condensation.

Feed water is passed through a Warren Webster 3000-hp. induced feed-water heater and purifier, raising the temperature to 212 deg. All boiler feed water passes through a 5-in. Venturi indicating, recording and integrating meter, having a 1⅝-in. throat diameter.

Piping

IN all plants of rapid and unexpected growth, requiring frequent changes and additions in both power units and building, without interruption to service, the piping problem becomes quite difficult. The boiler plant, up to a few years ago, consisted of one row of 6 boilers, with overhead coal bunkers and inclined coal chutes. With the necessary enlargement in capacity, the overhead bunkers were removed and another row of boilers installed. The necessary washout and blowoff piping had to be changed as well as the boiler header connections.

A 3½-in. single feed main, in front of each row of boilers in the basement, is connected to a common 5-in. cross-main which leads to the Venturi meter. A duplicate system of 5-in. mains connects with the 2 boiler feed pumps.

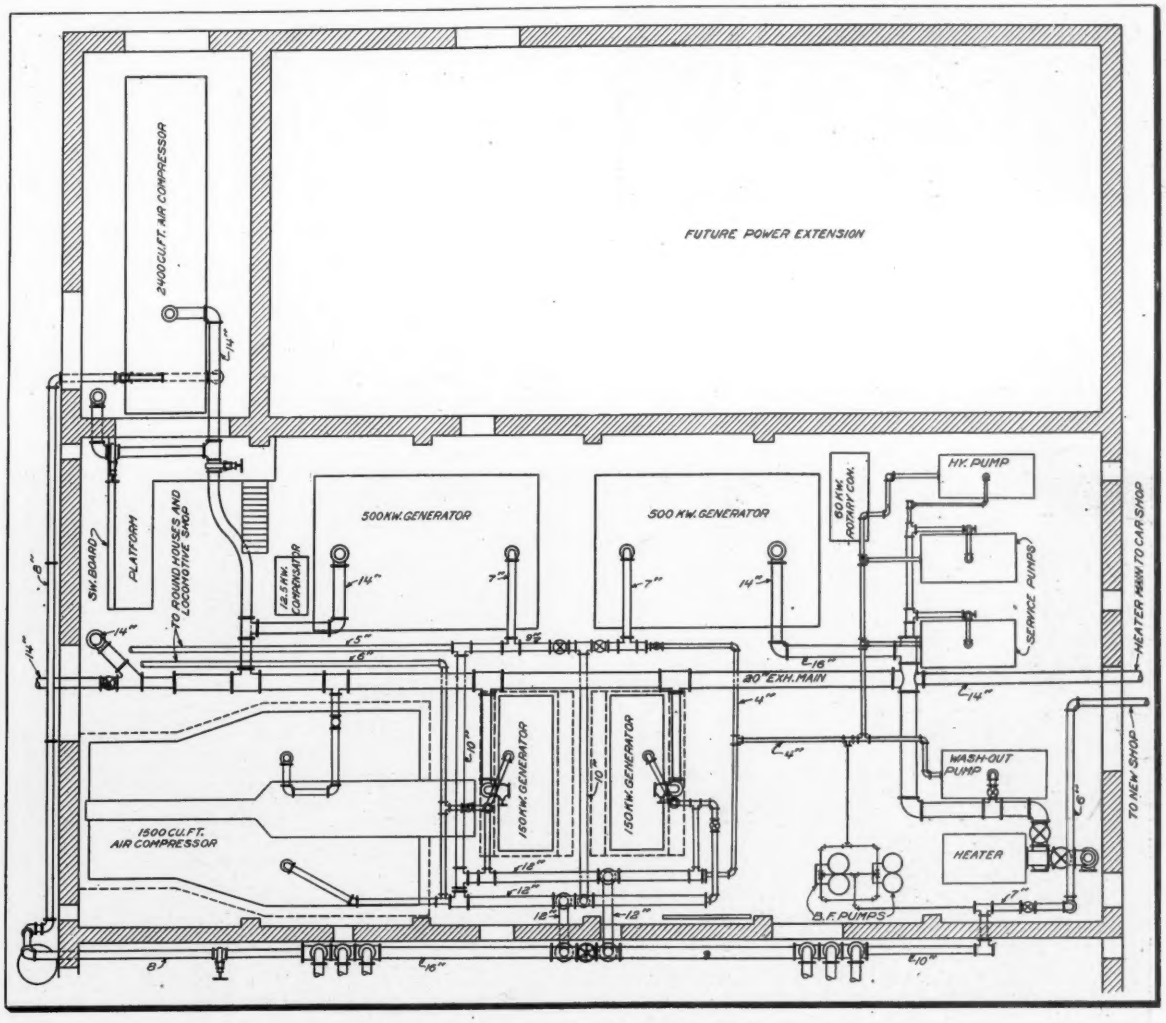


FIG. 7. PLAN OF ENGINE ROOM PIPING

Boiler and engine rooms are arranged on the back to back system of piping, with a 16-in. main boiler header back of the inner row of boilers. In this

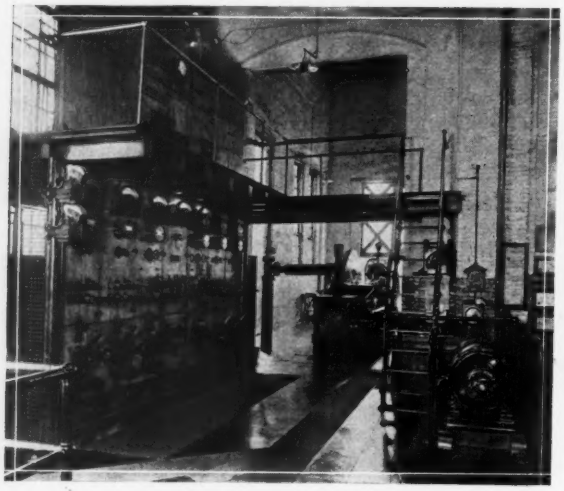


FIG. 8. VIEW SHOWING SWITCHBOARD, SULLIVAN AIR COMPRESSOR IN CENTER OF PICTURE AND WESTINGHOUSE COMPENSATOR AT THE RIGHT

row, every set of batteries is connected to a 12-in. branch line, which in turn leads to the 16-in. main. In the outer row, an 8-in. V-loop expansion pipe connects each boiler to a common 12-in. header, which connects to the 16-in. main through 2 12-in. branches, thereby forming a loop system. The main header is supported on wall brackets provided with rollers, for expansion; all other piping is suspended from the roof girders. At one end of the boiler main an 8-in. branch leads to the Sullivan air compressor while an 8-in. branch at the other end leads to a tee in the engine room, from which a 6-in. branch leads to the recently constructed locomotive shops. Five and 6-in. branches connected to the engine header and cross-connected to each other, supply steam for the old locomotive shop and round-houses. The live steam for outside purposes is used in testing and "blowing out" locomotives and also for filling those up preparing to leave from the round-houses for road work.

Two 16-in. pipes lead from the boiler header to the basement of the engine room where they connect to a loop, forming the engine header. From this loop the various branches lead to the power units and air compressors.

All exhaust steam from the engines, compressors and pumps is led to a 20-in. exhaust main, running lengthwise in the engine room basement, from which connection is made at each end with a 14-in. roof exhaust pipe, provided with a back pressure valve. The Sullivan air compressor has a separate atmospheric exhaust pipe, likewise provided with a back pressure valve. For locomotive shop heating purposes, a 14-in. pipe leads direct from one end of the exhaust main.

On an independent, 2-panel gage board are mounted the following: A station clock, whistle plugs, a recording steam gage and gages for the hydraulic pressure, compressor and intercoolers, engine receivers, exhaust main, washout and air mains, steam lines and vacuum return system. The Venturi meter is placed at one side of the gage board.

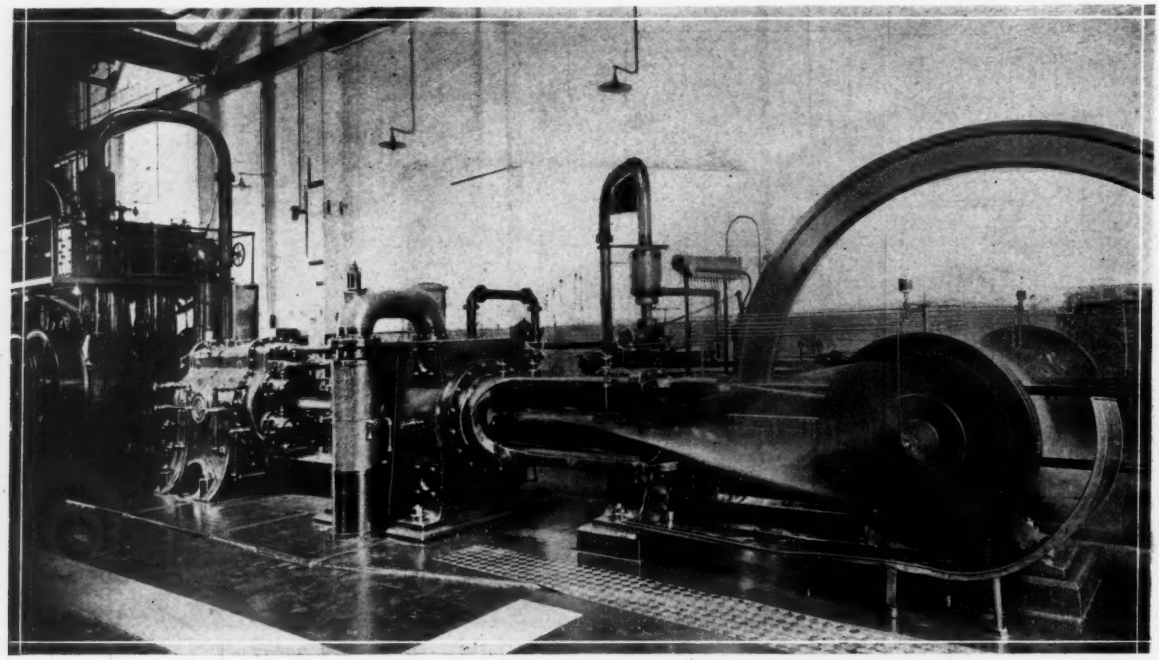


FIG. 9. 1500-CU. FT. AIR COMPRESSOR SHOWING OILING SYSTEM

Charles E. Chapman is in charge of the plant and F. J. Ravlin, who was the engineer in charge of the original electrical installation, is now the Chief Engineer of Power Plants for the entire C. & N. W. R. R. system. The writer is indebted to both for their information and suggestions.

HORIZONTAL RETURN-TUBULAR BOILER FOUNDATIONS

By W. O. Jones

BOILER foundations perhaps receive less attention than any other work of as much importance connected with power plant installation. On them depends the structural integrity of the boiler setting, and they should therefore receive careful consideration.

Due to the varying character of soil, no standard can be arrived at for proportions of foundations, and the superintendent of the work should be one having judgment concerning the nature of the soil in which they are to be placed.

In determining the proposition of foundations, the load to be sustained and the bearing value of the soil are the principal questions. The former is easily solved, as the weight of the boiler can be obtained from the manufacturer; or in cases where it is intended to make the foundations of such liberal proportions that the necessity of extreme accuracy is obliterated, the weight can be taken off the freight bill. The weight of water contained by a boiler when full to the water line is nearly ⅔ of the weight of the boiler, and when determining the weight on the foundations (exclusive of the masonry) it is safe to double the weight of the boiler. The weight of masonry can be figured at 140 lb. per cubic foot, and the setting plans (usually furnished by the manufacturer) give the dimensions of the masonry. With the method of support shown in Fig. 1, the weight of masonry is considered separately from the boiler and water, but with the method of support shown in Fig. 2 the weight of the masonry, boiler and water are considered together.

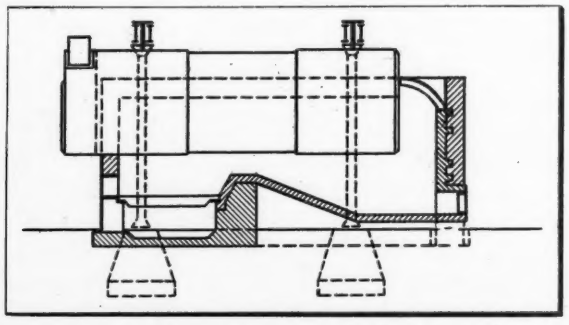


FIG. 1. SUSPENSION TYPE OF BOILER SETTING

Bed rock of course makes the best foundation bed, but is rarely located so that it can be utilized. When used it should be prepared to receive the load by removing the loose and disintegrated rock, roughly leveling the surface and filling the crevices with concrete. Next to rock, soil composed principally of sand and gravel confined to prevent lateral expansion has the greatest bearing value and can be figured at 6 to 8 tons to the square foot. Clay from hard, compact shale has a bearing value safely estimated at 6 tons per square foot. Mud and quicksand have no bearing value, while stiffer varieties of clay will sustain a load of 4 to 5 tons to the square foot.

The proportions of foundations must be such as to distribute the load over as much surface as is required to sustain it and provide suitable table to receive the load.

Foundations are usually made of concrete, the composition of which depends on the size of the aggregate (pebbles, broken stone, brick bats or slag). The matrix (cement and sand) must be used in sufficient quantity to fill the voids of the aggregate, and the cement should fill the voids in the sand. The usual approximate proportions for a good mixture are 1 part cement, 3 parts sand and 5 parts aggregate. If the matrix is used sparingly, porous and defective concrete will be the result. A thorough mixture is also necessary to produce a good concrete.

Concrete foundations, when in the form of piers or pedestals, are usually built in roughly constructed wooden forms, which are knocked out of place when the concrete sets. When the foundations are below the surface of the soil and the compact of the earth is sufficient to confine the soft concrete, the wooden forms need not be used.

Figure 1 illustrates the modern method of supporting boilers. The weight of the boiler and the water it contains falls on the 4 piers on which the columns rest. While the front piers may receive slightly more weight than the rear piers, this is sometimes equalized by placing the hangers a little nearer the front end. If allowance is made for inaccurate calculation of the bearing value of the soil by making the piers of liberal proportions it is safe to estimate that the weight of the boiler and the water it contains is equally distributed on the 4 piers. This leaves the weight of the masonry to be provided for. This is done by a slab of concrete, the width of which is usually such that it projects about 4 in. beyond the face of the wall on both sides to avoid the tendency of the brick in the lower part of the wall to become loose and be knocked out of place. The depth of the slab depends on the weight of the wall and the bearing value of the foundation bed. It may vary from 6 in. to 12 in.

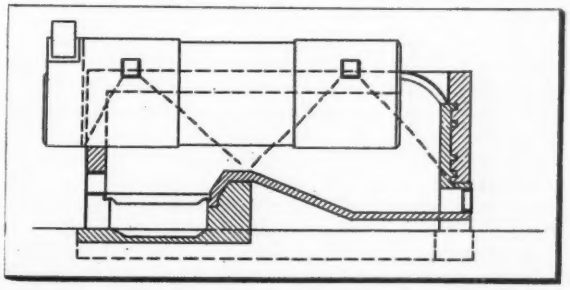


FIG. 2. BOILER SETTING FOR BRACKET SUPPORTS

Figure 2 shows a method of suspension which is fast becoming obsolete. When this is used the problem of distribution of the load on the foundation becomes complex. The load is transmitted to the foundations by brick walls. The higher the wall, the greater will be the spread of the weight as it nears the foundation. While there is no way to determine the exact distribution of the load with such a method of support, when the walls are in good condition, and the side lugs are about the usual distance apart and usual height above the foundation, it is safe to figure that the load is equally distributed over the surface of the foundations of the side walls. Allowance should be made, however, in such cases, as cracks and voids

that almost invariably develop in the walls due to expansion and contraction, destroy the adhesiveness or rigidity of the walls and the principal part of the load is then concentrated directly under the lugs. It is well to enlarge the foundations at these points so they will sustain the weight of the boiler and the water it contains, without depending on the adjacent part of the foundations.

WORK AND HEAT

Where Does the Steam Engine Get Its Power? Heat from the Steam Doesn't Seem to Account for It

By Karl H. Muller

IF we wish to express work done in terms of heat we first reduce the work done to foot pounds and then divide by 778. Joule found by experiment that 772 lb. of work was equal to 1 B.t.u., Rowland later corrected this and put this figure at 778, and this latter figure is now more commonly used. I have used this figure in some calculations I have made lately and the results obtained caused me to write this article for discussion by readers of Practical Engineer.

Let us assume 1 lb. of steam at 140 lb. per sq. in. absolute. According to the latest steam tables of Marks and Davis steam at that pressure has the following properties:

Temperature, 351.1 deg. F.
Specific volume, 3.219 cu. ft. per pound.
Density, 0.3107 lb. per cu. ft.
Heat of the liquid, 324.6 B.t.u.
Latent heat of evaporation, 867.6 B.t.u.
Total heat, 1192.2 B.t.u.

We want to allow this pound of steam to do work in the cylinder of an 18 by 18-in. simple noncondensing steam engine and to make the problem simple will neglect clearance and assume that the engine is in perfect condition. Cutoff is to be at ¼ stroke and back pressure at 15 lb. per sq. in. absolute.

At 15 lb. per sq. in. abs. steam has, if dry and saturated, the following properties:

Temperature, 213 deg. F.
Specific volume, 26.27 cu. ft. per pound.
Density, 0.038,96 lb. per cu. ft.
Heat of the liquid, 181 B.t.u.
Latent heat of evaporation, 969.7 B.t.u.
Total heat, 1150.7 B.t.u.

If we now subtract the total heat in one pound of steam at exhaust pressure from the total heat in one pound of steam at initial pressure, we get 1192.2 minus1150.7 or 41.5 B.t.u. as the total heat expended and this multiplied by 778 would give us 32,287 ft. lb. as the total work that this heat given up by the steam is capable of doing. This figure, however, is very much below what we get if figuring the work done by this pound of steam according to either one of two formulas which I have used.

It is probably best first to reduce the volume of this pound of steam and the volume of the steam cylinder both to cubic inches in order to find the number of strokes the engine would make on it. The specific volume of steam at 140 lb. abs. being 3.219 cu. ft., this multiplied by 1728 will give us the volume in cubic inches or 5562.43, the volume of the cylinder is $18\times18\times0.7854\times18$ and since cutoff takes place at ¼ stroke we may divide the result by 4 and get the volume of steam required per stroke or 1145.07 cu. in. and since we have 5562.43 cu. in. of steam, the engine will make 5562.43 divided by 1145.07, or 4.858 strokes nearly.

To find the work done per stroke we will first use the following formulas:

M.E.P. $\times$ A $\times$ L = work done per stroke, and
M.E.P. = P $\times$ (1 + hyp. log. R.) $\div$ R — back pressure

where P = initial absolute pressure; R = the ratio of expansion; A = 254.46 sq. in.; L = 1.54.; and the back pressure is 15 lb. per sq. in. absolute.

Since cutoff takes place at ¼ stroke, R = 4, and the hyp. log. of 4 is 1.386; then

M.E.P. $= 140 \times (1 + 1.386) \div 4 - 15 = 68.44$ and $68.44 \times 254.46 \times 1.5 = 26{,}123$ ft. lb. per stroke, and since 4.858 strokes will be done by this 1 lb. of steam, $26{,}123 \times 4.858$ or 126,905 ft. lb. will equal total work done.

This, as anybody can readily see, is nearly 4 times as much as that available from the heat given up by the steam, and we have to account for the difference between the 41.5 B.t.u. and 119.8, which is the heat equivalent of 126,905 ft. lb.

Before jumping to the conclusion that the difference is latent heat, given up by a portion of the steam in the cylinder, let us consider that, while there is cylinder condensation there is also re-evaporation toward the end of the stroke and that this re-evaporation continues after release as the terminal pressure is $140 \div 4$, or 35 lb. absolute and exhaust pressure is only 15 lb.

I should like to have the opinion of readers on this subject.

INTERESTING SMALL POWER DEVELOPMENT

OF interest, as showing the gradual development of small streams for the local use of power, is the hydroelectric plant which is being put in by the Andrew Terry Co., manufacturers of castings, Terryville, Conn. Use is made of an old dam across the Pequabuck River, the mill connected with which was burned down some time ago. This is located ½ mi. below the present factory and has been made the location of a new plant operating under 36-ft. head.

The prime mover, designed for 130 hp., consists of a pair of 12-in. wheels built by the S. Morgan Smith Co., York, Pa., and operating at 720 r.p.m., speed being regulated by a Lombard governor. The wheel is direct-connected to a Westinghouse 3-phase generator rated at a maximum of 135 kv. a. and delivering current at 2400 volts.

Water is carried from the dam to the wheels through a head race canal delivering into a steel penstock 42 in. in diameter and 325 ft. long. The dam provides a considerable storage of water and it is anticipated that when the entire project is completed there will be no demands made upon the steam power plant except for a few weeks in the extremely dry season.

Franklin Institute of Pennsylvania, acting through a committee of crafts and arts has awarded the Elliott Cresson gold medal, the highest gift of the Institute, to Prof. Albert Sauveur of Harvard University in recognition of his many and important contributions to the science of metallography and his influence in bringing this science into practical and useful application in the iron and steel industries.

BOILER INSPECTION

It Pays to Cooperate with the Inspector. Keep the Combustion Chamber Clear. Why Not Use Boiler Compound?

By W. M. Francis

AS between 2 questions, I have not decided which is more important: Repairing a boiler for inspection, or caring for it when the inspector is not around.

Is Your Boiler Ready?

AT times we find that getting a boiler ready for examination has consisted of letting the fire out; the ashes are still on the grate, the combustion chamber has a load limited only by the capacity of the space, and the tubes contain soot from the last run, which it has not seemed worth while to blow or scrape out. Inside the boiler, from which possibly the water has been drawn out, is a wet condition of tubes and shell, with a collection of scale below the tubes depending on the kind of water used. This picture is not general or even average, but in many plants some such condition is found upon arrival.

If the inspector properly performs his duty, he must have access to every part for examination and test, either by sight or sound. Imagine working about on the grate of a boiler with clinkers of various sizes imposing their presence upon your anatomy, while trying to determine the condition of fire surfaces, and to give careful consideration to such defects as may be located.

The shell from bridge wall to rear head is not as prolific in defects as some other parts of the boiler, but it must be examined, and frequently we have seen ashes filled in until they not only touch the bottom of the shell but have encroached upon the space at the sides between walls and boiler. The blowoff pipe has a way of showing various ways of trouble, from being entirely burned away to being filled with scale and split for more or less of its length.

The nearer we can get to the metal, the better is the chance of discovering defects, finding the cause and prescribing a cure. Right here it may be wise to consider the relation of the inspector to the plant and the engineer in charge.

Get the Inspector to Help You

TOO often the inspector's intention is misconstrued. Instead of being tolerated as a privileged faultfinder, he should be accepted as a help to keeping the plant out of trouble or to getting it out, and frequently will be found to have a fund of information collected from his wide range of observation, which he is willing to pass along to those less fortunate.

He must be impartial in his decisions about the safety of the boiler; find defects if they exist, and criticise practices which are against either safety or economy. Considering the responsibility resting on the inspector, from the moment he gives his approval for a certain boiler as good for a given pressure, you will agree that he should have all possible assistance in making a most complete examination. Not only property but human life depend upon his judgment, and it is to the interest of the owner and those who are obliged to work about the plant, that the obstacles be as few as possible.

I remember on one occasion getting into a boiler furnace which had been regularly inspected for a number of years, and finding, to my surprise, that the 2 front courses were shining like the top of a new stove. The plates had actually been gone over with a wire brush and then polished with black lead by the misguided engineer, who was his own fireman, to cover up a fire crack which extended from the edge of the plate back into the solid metal, perhaps 1¾ in. The man thought that his reputation as a careful fireman would be ruined if this crack were discovered, but he was finally persuaded that the same crack would have appeared regardless of who had been operating the boiler, and was shown that a hole drilled at the end of the crack and plugged with others behind it to complete the "sewing up" process would remove the trouble. He could not realize that even if the defect had got past the inspector, it was sure to come to light some day and might have developed serious trouble.

In a similar case, the rear head received black lead treatment to cover up a crack across the bridge between 2 tubes; and more energy was exerted in trying to fool the inspector than was required to make lasting repairs. The collection of scale noted while inside the boiler was a sure indication of what was to be expected on getting where the exterior could be seen.

Possibly a word as to how a plant can save part of the present running cost may be helpful. A fresh fire burning brightly across the back with a ridge of fresh coal at the front being coked, to be pushed back later on if properly handled, has been demonstrated to make an excellent smoke consumer.

Why Is a Combustion Chamber?

SPACE back of the bridge wall may affect materially the operation of the boiler, and you may not have thought that this is the reason why the bottom is sloped at a gradual incline from the ground to the wall. Without this filling there is a space where the gases form a swirl which retards combustion. A second wall has been advocated in some settings, seemingly to cause the gases to rise closer to the boiler; this hardly need be taken seriously, for heat will rise without persuasion, and with the sloping bottom and space free from ashes, the gases can expand and burn freely.

Pressure Drop Is Waste

FRICTION in steam piping does not receive the attention due it, and in many plants a test of the lines would show drop in pressure which is a serious handicap to economical working. In a plant in this country they were struggling for a number of years with 14 lb. drop in pressure; just think what that loss represented in an engine cylinder of average size, and it may be that some of your power machinery is working against just such odds and you wonder why efficiency and capacity are not what the rating calls for.

Compound in Ice Plants

RETURNING for a moment to the boiler; I am told that in making ice the use of compounds is almost prohibited for removing scale. Assuming that my information is correct, there is nothing to prevent

giving the spare boiler a thorough scaling, first having boiled it out with a strong solution of some compound which has been found to serve the need of your section. After the boiling process, a man should be sent inside with the tools to dislodge scale adhering to the surfaces. When he has reported the job as completed, see that he is right; it is not pleasant work, and unless someone follows to see that it is done, it is surprising how many corners are skipped and chunks left to make a foundation for additional deposit. If you cannot get into the boiler, a light run back under the tubes will, in a few moments, give an idea of how thoroughly the work is done.

I would suggest that you experiment with compound. Your patrons will consider you a candidate for the Ananias Club if you try to persuade them that they are mistaken when they think that they taste ammonia in the ice; so why not change their troubles occasionally and give them a chance to detect the use of compound. I do not believe they can do it, and if you can successfully work it, you will get better results from your fuel.

FINE POINTS IN INDICATING

Detail of Action in a Gas Engine Studied from Light Spring Cards

QUITE an important series of observations can be made from diagrams taken with a spring which will show the curves that lie close to the atmospheric line more distinctly than those on the usual "power" cards taken with heavy springs which enable the maximum pressure to be noted and from which the power of the engine can be computed. Indeed, the "light spring" cards, as will be seen from what follows, give information that is of the utmost value, and, after all, indicating should not be done merely as a means for computing the power developed by an engine, but to record defects, if any exist, so that the proper remedies can be applied. These defects can frequently be better observed from light spring cards than from power diagrams.

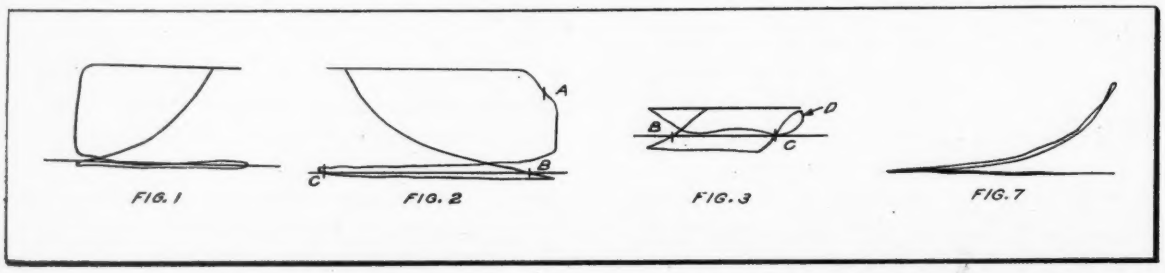


FIG. 1. CARD WITH 32-LB. SPRING, IDEAL ACTION
FIG. 2. DIAGRAM SHOWING EXHAUST RESTRICTION
FIG. 3. CARD FROM GAS ENGINE AT 475 R.P.M., 16-LB. SPRING
FIG. 7. COMPRESSION AND EXPANSION CURVES OF IDLE CYCLE WITH 100-LB. SPRING

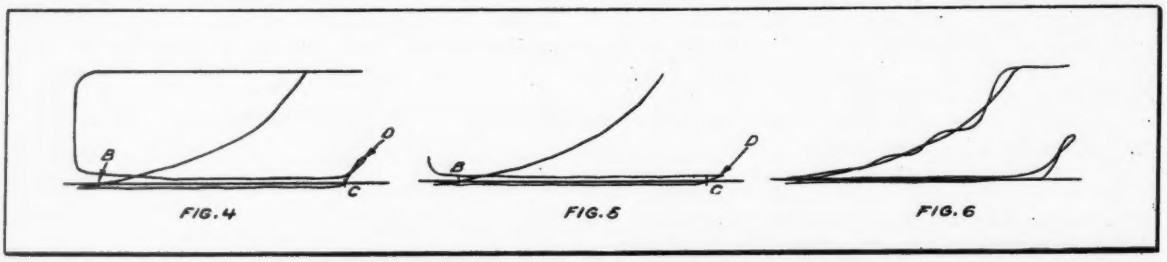


FIG. 4. BAD EXHAUST ACTION DUE TO WEAR OF EXHAUST VALVE STEM
FIG. 5. DIAGRAM WITH WEAR OF FIG. 4 CORRECTED BUT EXHAUST RESTRICTED
FIG. 6. ACTION OF GASES DURING CUT-OUT OF A HIT-AND-MISS GOVERNOR

Proper Spring

IT is necessary, however, to choose the strength of the spring with discrimination. A spring that moves through 1 in. for 32 lb. of pressure not only prevents undue oscillation of the pencil, but also, usually, permits the point of release of the burnt gases to be noted at the upper part of the diagram as in Fig. 1. The curve of the exhaust line can be studied, and although the point of release is not clearly seen, it can be noticed that there is a prompt fall of pressure at the left-hand end of the card which shows that effective exhaust of burnt gases was taking place. At the center part of the exhaust curve it is clear that the internal pressure was lower than that of the atmosphere, and while at the right-hand end of the diagram there is a slight rise, due probably to the effect of the muffler permitting the gases to expand and checking their velocity through the exhaust connections, yet, at the termination of the stroke, the pressure falls to atmospheric, showing that no undue restrictions exist.

Analysis of Light Spring Diagrams

THE lower curve starting from the right-hand end of the diagram shows that immediately upon the piston of the engine starting upon its outstroke, there is a lowering of pressure which indicates that drawing

in of the next charge has commenced. The parallelism of this line with that of the atmosphere shows that no undue restriction is occurring which otherwise would cause wiredrawing of the incoming charge, while at the left-hand end of the diagram it will be seen that the pressure rises almost to atmospheric. This indicates that the inlet valves remain open sufficiently long for full advantage to be taken of the inertia of the incoming gases, in that, although the piston has ceased to exert a pull upon the entering column of gas and air, yet the velocity of the latter due to the previous rapid motion of the piston is still great enough to permit the filling of the cylinder by the continued flow of the mixture through the open valve.

Again, it will be noticed that the point at which the compression curve crosses the atmospheric line is close to the left-hand end of the diagram, which shows that full compression pressures can be expected as long as the piston of the engine is a tight fit and the valves are seating properly upon their seats. Altogether, Fig. 1 can be accepted as an ideal diagram for the 4-cycle gas or oil engine, governed either by "hit-and-miss" or by the admission of graduated charges if, in the latter case, the engine is working at or near full load.

Attention may now be directed to Fig. 2. Here is a diagram similar to Fig. 1, but with the compression curve starting from the right-hand end. This is merely owing to the fact that a different style of reducing gear was used in the 2 cases.

In Fig. 2 the letters A, B and C are marked against short lines in different parts of the diagram. The first, A, indicates by the changed rate of pencil motion that the exhaust valve has commenced to open, just previous, in fact, to the steep drop in pressure at the right-hand end of the card, which coincides with the stoppage and reversal of the piston. It will be seen that in this engine there is considerably more restriction to the passage of the exhaust gases to the atmosphere than in Fig. 1, for not only does the pressure not fall so low at the beginning of the exhaust stroke, but the curve throughout the exhaust stroke is higher than the atmospheric line and slopes gradually throughout. As a consequence, it will be seen at C that the suction period is delayed, for no fresh charge can be induced to flow into the cylinder until the pressure within the engine cylinder has fallen sufficiently to permit the piston to exert a pull. That is to say, no mixture can enter until the internal pressure is lower than the atmospheric pressure to an extent depending upon the area of the valves and the speed of the engine.

Further, it will be noticed that the crossing of the compression line over the atmospheric occurs somewhat later in the compression stroke than is shown in Fig. 1, and this is in consequence of the failure of the gases to flow into the cylinder after the piston has ceased to move outwards.

High Speed Diagrams

FIGURE 4 shows how in a high-speed gas engine the bottling up of exhaust gases due to the early closure of the valve affects the suction stroke. In this it will be seen that before the suction curve has reached its lowest position which indicates that the charge is then being drawn in, a considerable portion of the stroke of the piston has been made. It will also be noticed the action of the governor in this instance, delayed the crossing of the compression curve over the atmospheric line until still later in the compression stroke than shown in Fig. 2. These curve formations of Fig. 3 were deliberate on the part of the makers, for practice has determined that with a fast running multicylinder engine, it is advisable to close the exhaust valve somewhat early, while such engines are always governed by throttle.

Effect of Wear

WHILE Fig. 3 is the result of intention, the diagram Fig. 4 is the result of neglect. In this case the exhaust valve closing too early, due to wear having increased the clearance between the end of the valve spindle and the adjusting screw at the end of the valve lever. When the latter was brought into contact so that the valve was opened for a longer period, Fig. 5 was obtained. It will be seen that a much better state of affairs resulted, although, due to restriction in the exhaust connections, even then the burnt gases could not get away sufficiently freely to bring the exhaust curve down to the atmospheric as in Fig. 1.

Cut-out Cycles

OWING to the absence of pressure within the cylinder at the end of the expansion stroke when no gas is admitted in "hit-and-miss" governed gas engines, there is no force other than that exerted by the returning piston to clear the cylinder in preparation for the entry of a fresh charge during the succeeding cycle. Therefore, the idle cycles of "hit-and-miss" engines always absorb more work from the flywheel of the engine than do "power" cycles as regards the exhaust stroke particularly, although this is contrary to what one might expect without fully considering the matter. Figure 6 is taken from the same engine and under the same conditions as Fig. 4, and it is plainly evident that the bottling up of exhaust in this case is much more than when the pressure of the gases within the cylinder at release brings the energy due to such pressure to aid in the work of scavenging.

Attention may well be drawn to the waviness of the expansion line in Fig. 6, which is entirely due to spring vibration. The expansion curve really follows the compression curve, but is slightly lower throughout, due to the passage of heat from the compressed fluid medium to the water-cooled walls; or, at all events, it should be lower according to theory. In practice, however, it frequently happens that, although the expansion curve upon cut-out strokes does fall below the compression curve at the higher pressures, yet as the curves approach the atmospheric line, the expansion curve rises above the compression line. This is probably due to the fact that while heat is lost to the water at or near maximum compression temperatures, yet as the temperature falls during expansion, heat is absorbed by the gases from the cylinder walls. That this is so is shown by reference to Fig. 7 from a National gas engine with a compression pressure of 110 lb., where it will be noticed that the expansion line is above the compression line at the bottom of the card, while at the top there is but little difference to be discerned.

It is always wise to take compression curves in this manner, as not only can the pressures be read off more correctly than from cards taken with heavier springs, but by the coincidence or otherwise of the compression and expansion curves at the top of the diagram it can be decided whether or not the piston is allowing pressure to leak past. It is, of course, important first of all to make sure that the reducing gear is properly set, otherwise such comparisons are of no value.—The Power User.

CHATHAM, N. J., LIGHT PLANT

Comment on Its Equipment, Performance and Success

THERE has just come to my attention an article published in Practical Engineer of July 1, entitled Small Community Power Station, by LeRoy W. Allison, describing the municipal power and light plant at Chatham, New Jersey, and incidentally holding it up as an example to be followed by other small towns.

Having made a close study of this plant and the reports issued from time to time by the Board of Water Commissioners, I feel that a number of statements and figures quoted from the Water Commissioner's reports might be misleading, and that the plant is not, in fact, so brilliant a success as the casual reader might think.

Speaking of "The equipment of the plant being intact" and the voting of "bonds for $35,000 for its extension," one might infer that the old equipment will be retained; as a matter of fact, little of the present apparatus will remain when the extensions are made, most of the money being used for replacements.

Analyzing the tabulations by which an apparent profit is shown by the plant, although practically the entire equipment has been worn out or is obsolete, no allowance has ever been made for depreciation. Had a proper percentage been set aside each year for this purpose, the plant, instead of showing a profit, would have shown several thousand dollars loss yearly.

Another item of the reports open to criticism is $612 credited yearly for the 36 lights used in the power house. These lights are a source of expense rather than a source of income. No account is taken of taxes that a private company operating the plant would be paying to the town each year, although this loss should be taken into account in determining whether the plant is a paying proposition or not.

In the published estimates of expected operating economy with the new equipment, total amounts estimated for labor, fuel, etc., are given, but without details, calculations, or basis. At least one discrepancy is, however, apparent; with an estimated consumption of 182,500 kw.-hr., the cost of fuel is placed at $2920. In a later estimate, an output of 365,000 kw-hr. is assumed, but the fuel is allowed to remain at the same figure, $2920. It is obvious that twice the output of current could not be generated for the same amount of fuel, even though a most amazing increase of efficiency were assumed.

In the comparison of steam and motor driven pump the cost of electric energy, if purchased, is taken at 3c per kw.-hr.; why, is known only to the one who prepared the calculations, for as far as public knowledge is concerned, no 3c proposition has been made to the town. It is known that a recently organized hydroelectric company has made a tentative proposition to supply current at ½c per kilowatt-hour, and that 2 other private companies have requested the opportunity of making a proposal, but as far is my information goes were not asked to state at what rate they would supply the energy.

While it must be conceded that municipal ownership, under ideal conditions, offers certain economic possibilities, we all know that the ideal in politics is seldom realized, and that municipal ownership cannot be divorced from politics, and in Chatham there is quite a general feeling that the plant has not been successful.

The design of the additional equipment created a good deal of dissension in the town, as a number of technical men who interested themselves in the matter believe that by a proper design a saving of some $10,000 could have been accomplished. The town now has about $100,000 tied up in the plant, no provision having been made for redeeming any of these bonds, and many of the tax payers are viewing with a good deal of apprehension the day when the bonds will come due, as schools, roads and other desirable public improvements are suffering for lack of funds which would otherwise be available.

I trust you will find space to publish this somewhat lengthy communication, to avoid erroneous conclusions which might otherwise be drawn from the reports as quoted in the article. Carter Wetmore,

Municipal Ownership Publishing Co.

As to the above communication, the information and data in the writer's article were obtained as follows: by a visit to the Chatham plant where he had the pleasure of meeting and talking with Mayor Kelly of the Borough, and with the chief engineer of the station; a published statement of the Board of Water Commissioners, signed by Dr. F. H. Lum, Chairman; A. M. Trowbridge, and W. M. Hopping; a published engineering report of such Board of Water Commissioners; and a communication of Emory N. Faulks, chairman of the finance committee, which was placed at his disposal.

It would hardly seem the province of any writer for publication to commend that which should be condemned, over his signature, neglecting the value of such to the engineering journal itself; yet to consider every remark of an interested person in the matter involved or any published reports relating thereto, as misleading and extravagant statement is scarcely extending the benefit of any doubt and common courtesy to the principals.

As to the bonds for extensions, the writer believes that in making alterations, improvements or additions to a plant they may reasonably be considered as an extension, in the parlance of the engineering press, as well as that of other mediums. Thus was the Chatham plant considered in current news, etc., wherever the writer had occasion to see, and thus was it considered by the Chatham Board of Water Commissioners and Borough Council when contracts were awarded last May for new equipment, and among other items, to Stull & Philhower, alterations and additions to power house, $1790.

As to the 36 lights in power house, total $612, credited to income in the report of the Board of Water Commissioners; such is quoted therefrom verbatim, and the writer has no particular comment. That it is open to criticism is evident, yet, on the other hand, if there was no power station there would be no necessity for these particular lights; but light would be needed at an individual water plant, eliminating the electric plant and purchasing the electric energy for entire operation from an outside source. Under such conditions this charge would seem legitimate.

The entire estimates set forth in the article were obtained from the engineering report of the Board of Water Commissioners mentioned above. The item of fuel which is here brought to notice may seem a discrepancy until one duly considers the present equipment and that to be installed. The present boilers have done service for about 15 yr., the present Corliss engine, 11 yr. This equipment could hardly be expected to show an efficiency in operation equal to that for which contracts have now been awarded. One, 100-kw. turbogenerator unit, Fort Wayne Electric Works, and one 75-kw., 2300-

volt, 3-phase generator and exciter, Fort Wayne Electric Works. While unable to state definitely, the writer is of the opinion that a contract for 2 150-hp. boilers has also been awarded, these being of the water-tube type. While the engineering report mentioned may err in the estimates of fuel cost, the difference, when differences in equipment are considered, does not seem so great.

Presumably the rate of 3c was placed as the result of reliable information accorded the Board during the 3 yr. of its investigations, and during which time considerable data has naturally been obtained. It may be possible that such a rate has been in force from the Commonwealth Water & Light Co., which operates in this section, and with which, up to a few years ago, the Borough had a very advantageous contract, allowing the switching of the municipal load to that plant when conditions required. The annulment of such contract, the writer believes, was on the part of the Borough when it commenced pumping all day.

It is hoped that criticism on Mr. Wetmore's part and the writer's reply thereto may be taken at their face value in conjunction with their source. The writer's article is based upon published records over the signatures of officials who are evidently thought highly of in their community, and who have been in office for years past to represent a prosperous town in its effort to obtain municipal ownership of its utilities and the efficient operation thereof.

LeRoy Allison.

THE WATER COLUMN

Connecting and Caring for This Important Boiler Equipment to Have It a Real Safeguard

By Receiver

TO ENSURE THE SAFE and economical operation of boilers, it is absolutely necessary that the fireman be able to determine the correct height of the water at all times and under all conditions of operation.

This height is shown by the gage-cocks and water glass if properly connected and cared for, hence would appear the importance that the boiler attendant give these careful and intelligent attention.

In boilers used for portable purposes, the water glass and gage cocks are screwed directly into the shell or head, and as the connections between the fittings and the boiler are short, there is little chance for them to become clogged. With larger boilers, this method of connecting is impractical and larger connections between the boiler and fittings are used.

Details of Arrangement and Connection

THE water glass and gage cocks are then mounted on some form of water column or combination box, Fig. 1, which is a casting of round or hexagonal cross section, and should have 3 bosses cast on each diameter across the column, on 2 places, for the reception of the gage cocks, and 2 bosses at right angles to the other 3, for the water glass, one near the top and the other near the bottom, as shown. This will enable the column to be used on the right or left-hand side of the boiler, to suit conditions. The length of the column is made to suit the size of the boiler to which it is to be connected.

The water column should be set at such a height in all types of boilers, that the top of the stuffing box on the lower or water connection to the glass is about one inch above the fusible plug. As all boilers are, or should be, set with the back end lower than the front, when water shows in the glass, the rear portion of the heating surface will be covered with water.

The column has the advantage over the connection of the fittings directly into the boiler, that only 2 holes are necessary, and as the top, or steam connection, should come from the steam space high up on the head of a return tubular, and the lower, or water connection, should be well below the water line (in fact, so low that when the front handhole plate is off, one may feel the opening to the lower connection and see whether it is becoming clogged) the connections are so located that the level shown in the gage glass will be free from the disturbances of the violent agitation of the water line in the boiler.

Small size boilers should have the connections to the column not smaller than one-inch pipe, and for larger boilers the size should be 1½ in. Only brass pipe of iron pipe size, should be used in connecting water columns, because the brass tubing used by plumbers is too thin and the threads are smaller than standard pipe threads. If iron pipe must be used, it should be extra heavy to withstand the corrosion and the gases of combustion which attack the iron.

No elbows should be used in connections, tees and crosses being recommended, and the opening not used,

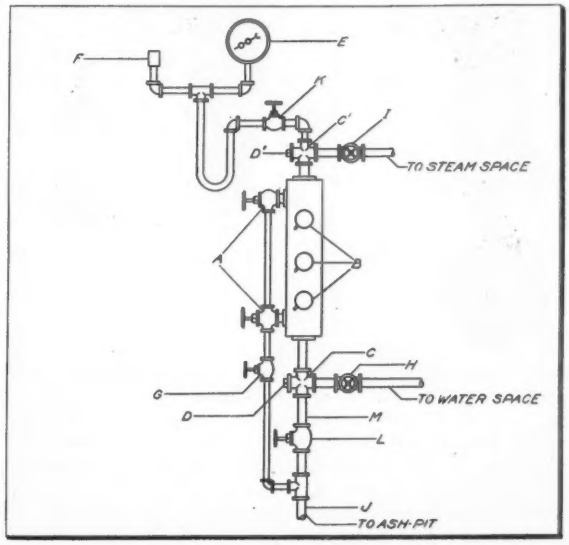


FIG. 1. DETAILS OF A WATER COLUMN AND CORRECT METHOD OF PIPING TO BOILER

plugged. Then when the boiler is washed out, the plugs are removed and the connections cleaned. Only ground unions should be employed in connecting the various pieces of pipe, as packed joints are unreliable.

Piping a Column

THE proper method of piping up a water column is shown in Fig. 1. The pipe leading from the top of the column to the steam space of the boiler, is connected into the top of the boiler shell, or passes through the front breeching in the horizontal tubular boiler, and enters the front head above the point where

it is desirable to carry the water. The cross C has a connection leading to the steam gage E. In providing this connection for the gage E, it is a good plan to arrange the pipe as shown, then the accuracy of the gage may be tested at any time by connecting a test gage to the coupling F.

From the cross C the water connection enters the boiler head or drum head, one branch of the bottom outlet taking the blowoff connection M, controlled by a reliable valve L, and pipe to the ash pit.

It is good practice to remove the usual pet cock that is sent with the lower water glass fitting and connect in a nipple and valve G, as shown, since the opening in the valve is larger and provides a freer discharge of the contents from the glass. This should be connected into the pipe from the column blowoff and thus discharged into the ash pit. No connection other than the steam gage should be attached to the column or its connections, as draft of steam or water through them will cause an erroneous reading of the water level.

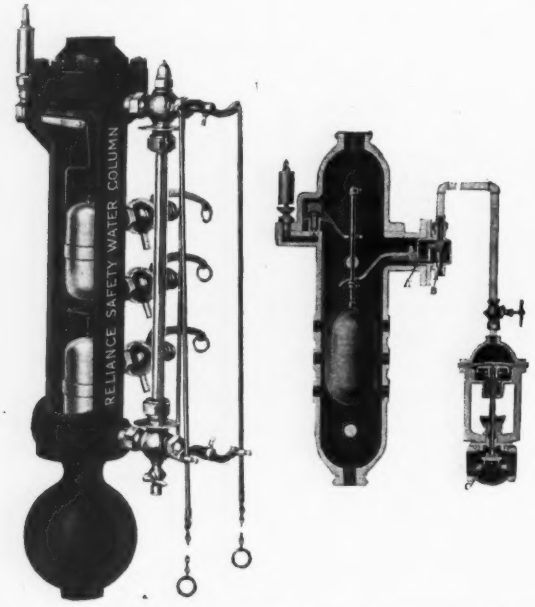


FIG. 2. SECTIONAL VIEW OF SAFETY WATER COLUMNS, RELIANCE AND WILLIAMS

The upper and lower connecting pipes from the boiler and water column should always be provided with the valves H and I, located within easy reach, which makes the column safer and more reliable, as the following will show.

In many boilers, the lower, or water connection, is subjected to the products of combustion, and as the circulation in it is weak, any deposits have a tendency to become baked hard in this pipe and so gradually reduce the area of the passage. In a column without the valves H, I, when the blowoff valve L is opened, the greater portion of the discharge from the pipe J is steam, because its velocity is greater than that of the water coming from the lower connection.

Blowing Down and Clogged Connections

DUE to the location of the steam connection to the column, it seldom becomes clogged, the greater danger being in the clogging of the water connection, for the reasons outlined. If a column is provided with valves, the top valve, I, may be closed and H remain open. Then with L open, the whole boiler pressure is concentrated on the area of the water connection, and the connecting pipe and fittings are thoroughly washed out, dislodging any soft deposits. The valve H may then be closed and I opened, which will thoroughly sweep the steam pipe, then open H and close L, when normal conditions are restored. The water glass should always be blown down in the same manner and for the same reasons.

Sometimes we see the connections to water columns enclosed by brickwork, especially when the boilers are at the end of a battery. This is to be avoided, as settling of the setting will subject them to strains that may cause trouble, and it also prevents the ready inspection of the pipe; when repairs are necessary, the brickwork must be removed and replaced.

Many object to the presence of the valves H and I in the connections of water columns on the ground that they are a source of danger. If a person operating a boiler cannot be relied on to see that the valves are open and the column clear, he is not a desirable employe for a boiler room and should be replaced at once.

If the upper, or steam connection, should become clogged, or the valve I closed, the pressure on top of the water in the column would be removed and the pressure entering the lower connection would immediately raise the water to the top of the column, and both water glass and gage cocks would show the water to be high.

Should the water connection be clogged, or valve H be closed, the pressure would remain on the top of the water in the column holding it down, while it was removed from the bottom, at the same time the water in the boiler might be rising or falling. The gage cocks would show a water level corresponding to that revealed by the glass. In time the glass and column would fill up from internal condensation.

Should the connections to the water glass become closed, while the connections to the boiler were clear, the indications of the glass would be affected in the same way as stated, for the same conditions in the water column, but the gage cocks would give the correct water level.

One of the best signs that both column and glass connections are clear is the gradual rise and fall of the water line in the gage glass, and the experienced fireman comes to rely on this motion to give him an idea of the behavior of the water in the boiler. When a boiler is forced, the circulation is more rapid than usual, and the rise and fall in the glass are greater. When a boiler foams, the water glass shows signs of this from the frothy appearance of the water and its violent rise and fall.

Safety Columns

TYPES of water column, called the safety column, Fig. 2, are often provided nowadays, especially in new installations. The floats ride on the surface of the water, and when the water rises to the top gage cock, the arm on the rod connected to the float opens the steam valve, admitting steam to the whistle. When the water level falls to the lower cock, the other arm on the rod opens the steam valve and the whistle again calls attention to the fact that the water level requires attention.

These columns should be so used that the fireman allows the whistles to blow, say, once a day to test their operation, but the water level should have constant attention, not depending upon the whistle, be-

cause when it blows, the water level has varied from the normal place and uniform conditions make for safety and economy.

When a gage cock or the blowoff valve L, leaks, and the column is provided with valves H and I, Fig. 1, they may be closed and repairs made to the valves, or any other fitting between the 2 valves, and replaced when convenient without waiting for an opportunity to let the boiler pressure down.

A Broken Gage Glass

WHEN the water glass breaks, the fireman should throw some covering over himself to reduce the danger of becoming scalded when ascending to shut off the glass when the column is provided with the plain type of fittings shown in Fig. 1. The lower one should be closed first, because the chances of being scalded with flying water are greater than from steam. When the lower valve is shut, close the upper one.

Remove the broken glass and both stuffing boxes. Then flush out both top and bottom fittings, making certain that no fragment of glass or old packing remains. In inserting a new glass, due care should be exercised that it is the right length, that the fittings are in line and that the packing prevents the glass from coming into contact with the metal. Then open the blowout valve from the glass; gradually open the steam connection and slowly warm up the glass. When warm, open the water connection gradually and when all appears right, close the blowoff valve G. During all this, it is well for the fireman to turn his face away from the glass, because when first subjecting a new glass to pressure it is especially liable to break, and many have been seriously cut or scalded in this way. Care must be exercised that the top stuffing box is tight, because a slight leak will cause a false water level in the glass; yet the packing should be only moderately tight to allow for expansion.

The water glass should best be provided with a quick closing attachment to shut off connections without the necessity of using a ladder and the chance of being burned. In some of these devices a lever is connected to the valve stem and operated by a rod. A chain comes from each end of the lever to such distance from the floor as to be within easy reach. Others of automatic type have a ball or valve that is seated by the pressure rushing from the fitting, thus stopping the flow of steam and water.

The water column is one of the most important of boiler mountings, one that receives much attention as to its proper connection, care and operation, in examinations for license, and should be thoroughly understood by all.

CORRESPONDENCE OF AN OLD ENGINEER AND HIS SON

Crooks and Crookedness

MY DEAR SON DONNY:

Your very welcome letter of several weeks ago was received in due time and we both enjoyed it so much. I read it over to Mother while she sat beside her little table piecing a quilt, which by the way is fast becoming a lost art.

We were much amused at the ways and means inaugurated by the oil agent to secure a continuance of his goods in your plant. But that is the way of the world. Some of these agents, not only for oil, but for many other things used about the plant as well, are so crooked that they could walk a rail fence with their eyes shut.

But although I suppose the evil will never be entirely stamped out, yet today a man has got to be pretty near square in order to get a living and the squarer he is, the better living he will get. There was a time (about when you were a boy) when it seemed to be common practice for every one to buy what they wanted in the way of politics and orders.

Men, (well, hardly men,) would spend 10 times as much to get elected alderman as the job was worth, usually on the plea that "he had been called upon by his constituents to take the nomination, and would do all in his power, if elected, to work for the best interests of the public, whose servant he was."

He would sacrifice his private interests for 2 yr. or so and retire well heeled, buy a strapping team of blacks, build a swell mansion on the boulevard and not do a tap for the rest of his days.

Spending $1000 to get elected to a $300 office and buying up the best in town after retiring, always seemed to me to be quite a puzzle. Then the unscrupulous agent appeared in the field. He had really begun to be a nuisance back when I ran engine in Philadelphia before the war. To be sure, there wasn't the vast amount of appliances then that there is now, but there was an over supply of ignorance and prejudice, (I know, because I had these ailments myself,) and when an agent could not get an order any other way, he would buy it.

The habit grew till the very mention of the name agent, made the listeners clap their hands over their pockets. Then the reaction came, and the crooked salesman was crowded so hard that he left the game. They never reform.

All men are born honest; many remain honest; and no one ever had honesty thrust upon him. When a man goes crooked, it is all off with him. You are young yet, Donald, but in your few brief years did you ever see a crooked man succeed?

Oh yes, there are many instances where a man runs a crooked deal right along and has all of the earmarks of success, that is, as far as a display of this world's goods is concerned. But, did you ever see such a man retain the respect and good will of those in the community in which he lives? You never did.

A crooked man is never trusted even by those of his class while a square man always has the respect of all, straight or crooked. Today is the time more than any other when it pays to be absolutely on the square, honest and aboveboard, no matter what you do.

Today, there are more jobs going begging for men of known exemplary habits than at any other time within my memory. Many men are hired, not because they are the men for the job, but because it is the best that the boss can do at the time. That may sound funny to your young mind but it is so.

Suppose a fireman is wanted. The news gets abroad and the woods are full of them. Oh yes, they are all firemen. Fired so-and-so many years here and so-and-so many there till they are liable to retirement on a pension for old age.

You make a selection out of the job lot and 9 cases out of 10 he is far from perfect, yet it is the best that can be done. You fear that if you change you will get something a great deal worse. But to get back to the main line again.

There are too many men at the bottom. Many of them stay there because they are not on the square; others for various reasons the principal of which is that they think that it does not pay to work for something better. They don't stop to realize that when opportunity comes along, it is not going to kick the door open to get at them.

They say that opportunity knocks at least once at every man's door, but if it knocks a dozen times, you have to open the door yourself and invite it in.

And it is said (and I believe that it is true myself) that no matter how far a man strayed from the straight and narrow path, no matter how crooked and unscrupulous he is or has been, there is always an opportunity presented some time or other for him to straighten up and be a man.

If the time, energy and generalship which some men put into a crooked game were put into something legitimate, what a world full of hustlers we should have, shouldn't we?

This something for nothing strikes a good many and it strikes them hard. Easy money is an almost incurable disease. Tell a man that you will give him something for nothing and he will bite every time.

Now to go back to the crooked oil agent. The brain work that he excercised pulling off that deal was worthy of a medal, but he wasn't on the square, and he fell. Of course, you and that young man,—Crissy, is that his name?—really did some good work in bringing his career to a close; but, if you hadn't done it at the time, it would have happened some other time, for when a man is ripe to take a drop, it is coming in one form or another.

Now, stop and think what it means to that man. You cannot keep such things hidden. They are bound to come out and the more effort there is made to conceal, the more disastrous the results. Then the farther it travels, the worse it gets, till finally it is pretty well noised about.

No matter what he does then, no matter how he strives to repair the damages, it will stick to him like a burr. In future deals in the community where products which he handled are desired, the consumer naturally thinks of him as one who will not be considered because he isn't on the square.

A person may "bluff it out" sometimes but unless he has the wherewithal to back up his bluff, he is doomed to a short shift. Now, in a case like yours, how much better it would have been for that oil agent to have gone to the Chief and made a clean breast of it that he didn't know what was the cause. Put it right up to him like a man, and the Chief would probably have gone into the matter with him, and both would have been lots wiser. As it is, the Chief got all of the wisdom.

There is more to cylinder oil than changing the name on the end of the barrel. Still there are many engineers who are susceptible enough to take the bait. That is like a young fellow a number of years ago who had charge of testing engines for a company who made a large number of threshing engines in a little town not far from where your mother and I lived at the time.

His name was Wardwell, and he was of the new breed which was just coming into vogue then; viz., a college man. Personally, he was a nice fellow but his knowledge of the game was about 30 per cent minus. He was boss tester. Two young lads had the job of setting the valves, and when one does a job like that several hundred times, he either becomes letter perfect or else careless.

These boys, Frank Batts, and Frank White, knew the job, and knew it well, but Wardwell thought differently first, about every day the boys would be called back to go over the valve setting on some engine, and of course, could not find anything wrong.

Still the boss wanted something changed, "because he said so." And the boys tightened and loosened the nuts and left things as before. This kind of business got monotonous, and it simmered down to going over to the engine, twisting the flywheel around a few times with a monkey wrench, and telling the boss they had gone over the valve and set it right.

Later on the boys didn't go near the engine that was alleged to be defective, but the boss would go over to the engine later, check up the valve gear again and then putting on a wise expression say, "Yes, that is all right now. Why didn't you do it that way in the first place!"

So I suppose that there always will be men who can be imposed upon by changing the label on the end of the oil barrel, and others who do not know when a valve is set right the first time they look at it.

But, Donny boy, there is no investment that pays such large dividends as "being on the square"; and none where the stock is a drug on the market like being so crooked that you will have to sleep on the stairs. Affectionately your father,

MacDougal.

COST OF HEAT, LIGHT AND POWER FOR HOTEL BUILDINGS

By R. L. Rayburn

I HAVE been much interested in watching the articles which have appeared from time to time on the Cost of Heat, Light and Power for Hotels, and the comparisons which have been made between the cost if purchased from the central station and the cost if furnished by the private plant.

There are generally 2 advantages that the isolated plant has over the central station service: first, economy; second, improvement of service.

This refers to the plant which is properly managed; and it must be conceded that any business must be properly handled to bring the largest returns. If it is not properly handled, failure, if it comes, may be due to poor management, and not necessarily to the principle involved.

The figures presented herewith are from a building which receives its heat, light, power, refrigeration, etc., from its own private power plant at a net saving of about $4000 a year over the cost if purchased from the central station.

For the plant in question, the actual figures charged by the central station for service in buildings of the same size as the building in question, have been taken and compared with the actual cost of the same service when furnished by the private plant. The figures for consumption are not estimates, but are carefully figured from the daily reports of the operation of the plant for the year.

The plant referred to furnishes service for a building containing 1,100,000 cu. ft. and consists of 2 140-hp. fire-tube boilers, 2 110-volt direct-current generators direct connected to 14 by 14-in. high-speed engines, and such other accessories as go to make up a modern power plant.

By referring to the accompanying statement, it will be seen that in figuring the interest on the investment, the cost of the erection of that part of the building containing the plant, has also been taken into consideration. The interest on this space has been figured at only 5 per cent because it is in the lowest and most undesirable part of the basement.

By looking over the statement, it will be seen that after paying 5 per cent on the total investment and 5 per cent depreciation on the equipment, there was still left a net saving of $4160.41.

The service furnished by the plant including several things which it was difficult to figure in the account showing the cost if purchased from the central station, such as live steam used on steam tables, coffee urns, etc. The expense of these, if purchased, would probably add $200 more to the cost of the central station service.

As to the reliability of service, the plant in question has operated nearly 2 yr. with 1 interruption of service of about 5 min. duration, while the central station service has been cut off 3 times during that time. One of these shutdowns was of about 3 hr. duration, and came just a little after dark so that those using central station service were in darkness the entire evening.

Cost of Power Plant Service for Hotel Building as Compared with Cost if Purchased from Central Station

Cost of Plant:

Cost of erection of that part of building occupied by plant, figured at 25 cents cu. ft.	$5250.00
Engines and generators	4800.00
Boilers	2350.00
Boiler settings	796.00
Pumps	152.50
Switchboard	1860.00
Ice machine and freezing tank	1400.00
Feed-water heater	255.00
Oil burning system	850.00
Return pump and tank	127.00
Pipe work and installation	2500.00
Total investment	$20,340.50

Cost of Service if Purchased from Central Station

Light, 123,704 kw. at 3½c	$4329.64
Power, 31,824 kw. at 3c	954.00
Refrigeration, 1 1/5 tons per day at $2.70 a ton	1182.00
Ice, 250 lb. per day (313 days only) at 22c	172.15
Lamps	144.00
Salary of engineer to care for elevators, plumbing, steam fitting, laundry machinery, electric wiring, etc. at $85.00 a month	1020.00
Extra help needed by engineer at $15.00 a month	180.00

Heat for winter season, 6 months:

Average live steam, per hour	2069 lb.	
Average live steam, per day	49,656 lb.	
Cost per day at 45c per 1000 lb.	$22.34	
Cost per season of 182 days at	22.34	4065.88

Water heating for winter season:

187,500 lb. per day from 50 deg. to 100 deg. F.—9,375,000 heat units per day.		
9,375,000 heat units—condensation of 9705 lb. steam from and at 212 deg. F.		
Cost of 9705 lb. steam at 45c per 1000 lb.	$4.36	
Cost per season of 182 days at	4.36	783.52

Water heating for summer season:

187,500 lb. per day from 70 deg. F. to 100 deg. F. 5,765,000 heat units per day.		
5,765,000 heat units per day—condensation of 5967 lb. of steam from and at 212.		
5967 lb. steam costing 45c per 1000 lb. at $2.68 per day.		
Cost for season of 182 days at $2.68 per day		487.76
Total cost		$13,318.95

Actual Cost of Heat, Light, Power and Engineer's Services

Labor	$2360.00
Fuel Oil	4488.00
Water	90.00
Oil, waste and supplies	100.00
Boiler compound	180.00
Insurance	25.00
Lamps	144.00
Total paid out	$7387.00
Cost, if purchased from central station	13,318.95
Actual cost	7,387.00
	$5,931.95
Depreciation on equipment	754.52
Interest on entire investment at 5 per cent	1017.02
	$1771.54
Cash paid out	7387.00
	$9158.54
Total including depreciation and interest on total investment	$9158.54
Cost, if purchased from central station	13,318.95
Total including depreciation and interest	9,158.54
Net savings	$4,160.41

FINDING AS A RESULT of its experience in testing the installation of cables for high voltage, that the use of the ordinary voltmeter is not sufficiently accurate because of the distortion of the wave form, so that the actual voltmeter reading is not 0.7 of the maximum value of voltage, the Simplex Wire & Cable Co., has undertaken the development of a new form of voltmeter devised by Prof. F. A. Laws of the Massachusetts Institute of Technology and Chester L. Dawes of Harvard University, which operates somewhat on the principle of an oscillograph, but instead of giving the wave form indicates by a straight line motion the limits to which the voltage rises in either direction. This instrument does not show the average voltage on the line, but is of use in showing the maximum voltage present in generators, transformers, motors or transmission lines so that the actual strain on the insulation can be determined.

Electrical Machinery and Appliances

For Generating, Transmitting and Using Current

CONNECTING TRANSFORMERS AND MOTORS IN INDUSTRIAL PLANTS. I

Arrangements of Transformers for Highest Efficiency and Convenience

By A. L. Temple

TO those who have to install tranformers and alternating-current motors, data on voltage, arrangements through connections, sizes of transformers and the wiring of motors with and without starters is most useful. The writer has found that few handbooks contain complete information on this subject and that the data of most practical use must come from experience and practical work supplemented by the data that may appear from time to time. The writer has found it most convenient to copy or clip interesting practical data on electrical installations and paste such into a notebook where it may be referred to when occasion comes up. In what follows, information will be given that will enable the electrical engineer or plant superintendent to lay out and install transformers and wire alternating-current motors with little guesswork.

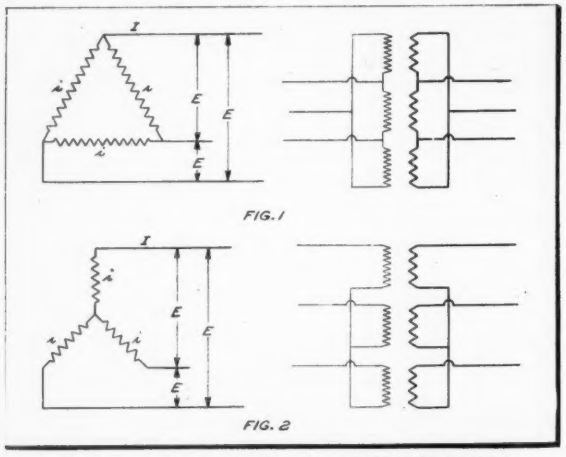


FIG. 1. DELTA CONNECTION OF TRANSFORMERS
FIG. 2. Y OR STAR CONNECTION OF TRANSFORMERS

The selection of sizes and the proper connection of transformers in a small plant is of as much importance as in the large one. Often there are particular circumstances that demand special arrangements and the plant engineer is called upon to work out systems that will best suit the apparatus that may be at hand. His ability to do this and make use of apparatus that may be standing idle and considered a capital outlay on which interest and depreciation is paid, will in many cases have a decided influence on his employer when considering an increase in salary.

Transformer Connections

STANDARD 3-phase connections for transformers using single phase transformers are given in Figs. 1 and 2. The first is known as the delta connection and the second as the Y or star. When transformers are to be installed in industrial plants and supply current to 3-phase alternating-current motors, the delta connection is better for 2 reasons. If one transformer becomes damaged for any reason, it can be taken out of the circuit and the connection made as in Fig. 3 so that the motors can still be operated until the transformer is repaired. It must be remembered, however, that if the 3 transformers are loaded to their capacity when connected in closed delta, they will be considerably overloaded when connected in open delta, so called, as shown in Fig. 3. It will not be wise, therefore, to operate for a long time with more than full load when the transformers are connected in delta which will mean an overload of about 42 per cent on the 2 transformers connected open delta.

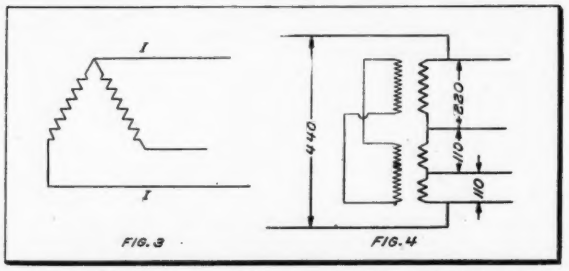


FIG. 3. THE OPEN DELTA CONNECTION FOR 2 TRANSFORMERS
FIG. 4. CONVENIENT CONNECTION FOR EXTENDING LIGHTING SERVICE

This is observed from the fact that under ordinary conditions when the 3 transformers are connected in closed delta, each transformer carries about 58 per cent of the line current. When connected in open delta each transformer must carry all the line current, which means when they were loaded to their capacity in the former arrangement that they are overloaded 42 per cent. This overload can be carried for short periods and may mean a great saving in permitting the plant to continue operation.

The second reason in favor of this arrangement of delta connection is that smaller sizes of transformers can be used than in the star connection, for the reason just stated that the current taken per transformer is 58 per cent of the line current. For the star connection the

current taken per transformer is the same as the line current. This advantage is greatest for low voltages such as are used in industrial plants since for high voltages, that is up in the thousands, the insulation must be better in the delta connection than in the star for the same service. This is on account of the fact that for the delta connection the voltage per phase or that impressed on each single-phase transformer, is equal to the line voltage while for the star connection it is 58 per cent of the line voltage. The relations of line current and transformer current and also of line voltage and transformer voltage are as follows:

Delta Connection	Star Connection
$i = I \div \sqrt{3}$	$i = I$
$e = E$	$e = E \div \sqrt{3}$

Where i is the transformer current and e the transformer voltage, I is the line current and E the line voltage.

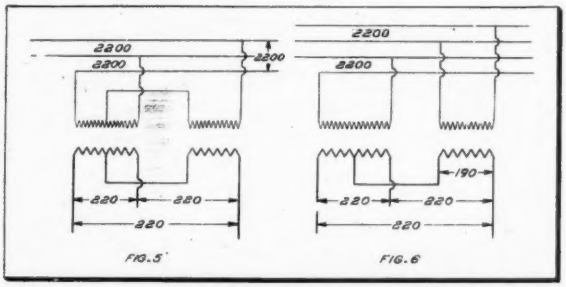


FIG. 5. THE T 3-PHASE 3-PHASE TRANSFORMER CONNECTION
FIG. 6. TWO-PHASE THREE-PHASE TRANSFORMATION

While the delta and the star are the standard connections and are recommended when possible to get the proper voltages by their use, it is often necessary to get other voltages for the best operation and this can often be done by proper connection of the transformers. For instance, it is most desirable to have all lighting at 110 volts, with motor service at 220 and 440 volts. In a plant it may be necessary to make extensions to the lighting circuits in excess of the present transformer capacity and yet it is not deemed advisable to purchase extra transformers to reduce the voltage as perhaps there are some 220-volt transformers not in use. The 110 voltage can

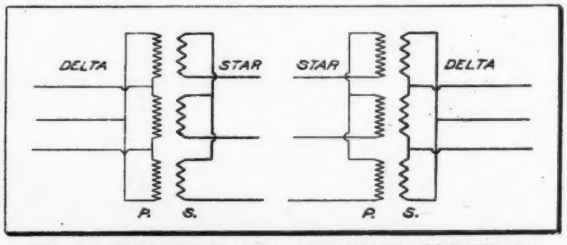


FIG. 7. DELTA-STAR AND STAR-DELTA CONNECTION

then be secured as shown in Fig. 4. Two transformers are shown here in series on the 220-volt side and in parallel on the primary side. The transformers should have a capacity equal to the load.

Also it may happen that a 3-phase load is to be connected and only 2 odd transformers on hand. In this case the T connection is the best to use as shown in Fig. 5. For this connection, it is seen, that one transformer has a voltage of 86 per cent of the other so that when one has a rating of EI the other can have a rating of 0.86 EI and the operation be satisfactory. It must be noted, however, that the transformers must have the same ratio of turns and that one must be provided with a tap at the center of the primary and secondary windings. While, as stated, for the best operation in T connection 86 per cent of the voltage should be impressed on one transformer, the normal voltage of one of the transformers can be 90 per cent of the other and even transformers of the same normal voltage can be used in T with as good results as in open delta connection. In the latter case, however, when the transformers will not be too badly overloaded the open delta connection should be used.

The T connection shown in Fig. 5 can also be used to transform 3-phase into 2-phase or 2-phase into 3-phase, the connections being those in Fig. 6.

The ratio of the right-hand transformer in Fig. 6, to make the connection satisfactory, must be arranged so as to give the voltage as indicated or transformers connected on the 2-phase supply so as to reduce to the extent of 13 per cent of the 2-phase supply voltage.

Further, the star primary connection and the delta secondary connection may be of use when it is desired to reduce a line voltage to something lower for service. It is possible for a makeshift connection, for instance, to connect the primary of a 2 to 1 transformer in star on a 440-volt line and the secondaries in delta and get 127 volts for lighting In this case, however, the lamps used must be suited for this voltage so that the life will not be reduced. Also, by connecting the line side of the transformers in delta and the secondary in star a means is provided for the grounding of the system.

CONSTRUCTION IS TO BEGIN shortly on the large Naval wireless station at Caimito, to be known as the Darien Radio Station. This is to be a 100-kw. plant, of the same power as the Arlington station, near Washington. In the size of its towers it will exceed the latter; all of the 3 masts will be 600 ft. high, whereas at Arlington one of the towers is 600 ft. and 2 are 450 ft. high. The bases of the towers will be about 180 ft. above sea level, and they will be arranged in a triangle, approximately 900 ft. on a side. The sending and receiving radius will be nominally 3000 miles, so that communication may be held direct with the Arlington station and with San Francisco, 2785 miles away by air line. The present stations at Colon and Balboa will be continued in use, to handle messages for ships using the Canal, and the Caimito station will be used exclusively for official business of the Government principally as a relay station for communicating with ships of the Navy in southern waters. It will be able to send messages as far as Valdivia, 421 miles south of Valparaiso; and, on the Atlantic side of South America, as far down as Buenos Aires. It could reach a vessel anywhere along the eastern coast of the United States, or midway between New York and Gibraltar, on the Mediterranean route; in approximately east and west lines, it could communicate with the island of St. Vincent, 500 miles west of Africa.

UNSUSPECTED SOURCES of danger are continually being discerned for us by the ever present newspaper reporter. In a recent Massachusetts trial for operating a boiler without license, the newspaper man has it that the inspector said the boiler was especially dangerous to operate as "the blowoff pipe had no asbestos covering to make it safe." Will somebody kindly explain what element of danger is removed by covering a blowoff pipe with asbestos?

CONDUIT WIRING

Electrical Conduit Fittings and Methods of Supporting Cables

By O. N. Casey

THE same dies that are used by steam and gas fitters for threading pipe, are used for threading conduit. It is usual practice when a lot of conduit is received, to rethread all of the ends which may have become filled with paint or dirt, or distorted by blows. Rethreading will save more than its cost, in that it insures rapid erection. Always ream conduit after cutting a thread on it.

Pipe threading machines for threading conduit, preferably those operated by motors, should be used on big jobs, and will soon pay for themselves in the time that they save.

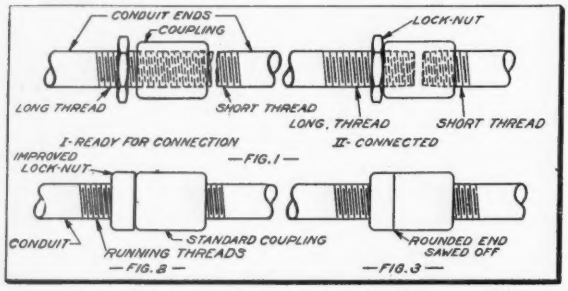


FIG. 1. RUNNING THREAD JOINT
FIG. 2. LOCKNUT SAWED FROM COUPLING
FIG. 3. COUPLING END SAWED OFF TO MAKE FLUSH JOINT

Running thread joints, Fig. 1, are sometimes used when it is necessary to connect the ends of 2 lengths of conduit—neither of which can be turned. Running threads are often used in making repairs to, or alterations, in existing conduit installations. The function of a running thread joint is similar to that of the pipe union used in steam and gas fittings.

To make a running thread joint, the thread on one length of conduit is cut sufficiently long that the coupling can be run entirely on it while the adjacent length is being fitted into position. The adjacent length has

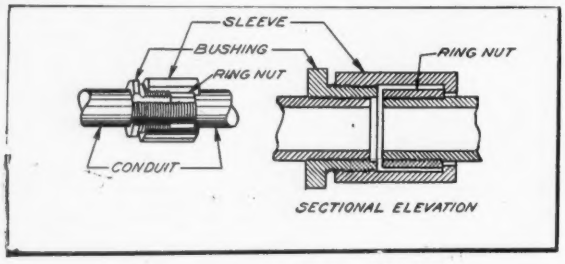


FIG. 4. THE ERICKSON COUPLING

the usual "short thread." After both lengths are in position, the coupling is turned until it wedges up tightly on the short thread. About half of the coupling should, in the completed joint, rest on each length, Fig. 1-II.

On the long thread length, a lock-nut should be used, as shown, to hold the coupling firmly in the conduit, as it is apt, otherwise, to fit loosely because of the long thread. An excellent lock-nut can be made by sawing off, with a hack-saw, about one-third of a coupling, and using this third, as shown in Fig. 2. The standard hexagonal conduit lock-nut often gives trouble, because it has only a few threads and they may be "loose." Where a very neat job is required, saw off the rounded end of the standard coupling, so that the sawed end of the improvised coupling-lock-nut will have a square surface on which to abut. See Fig. 3 for an illustration.

The Erickson coupling, Fig. 4, was devised for the same applications as those for which the running thread is used. The illustration shows the construction of the device.

The Stilson wrench appears to be the most popular for turning conduit. Chain wrenches are not as yet much used for conduit work, but in instances

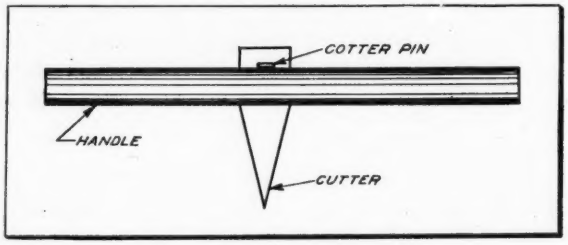


FIG. 5. AN EFFECTIVE REAMER

where they have been tried, they have proven satisfactory. Their advantages lie in the facts that they can be used with one hand after the chain is around the conduit and that they can be used in confined places and close to walls where a Stilson wrench could not be utilized.

Conduit ends should always be reamed. A reamer which can be turned by a bit brace, is a good tool for small and medium size conduit. For conduit of the larger sizes, reamers can be obtained which have long handles attached, giving the needed leverage. Another good form of reamer is shown in Fig. 5. The advantages of a reamer of this type are its simplicity and ruggedness, and the ease with which it can be

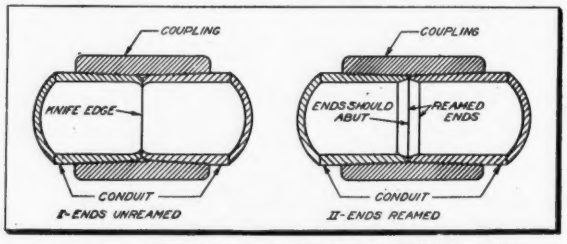


FIG. 6. UNREAMED AND REAMED CONDUIT ENDS

sharpened when dull. Although reamers of this type can be purchased at plumbers' supply houses, a wireman can, if he chooses, have one made by any blacksmith. A piece of pipe or bar of wrought-iron can be used for the handle, and the tool steel cutter can be held in a slot in the handle with a split cotter pin. When conduit is received, and after it is cut, the ends are frequently turned in, (Fig. 6-I), and when screwed together in a coupling, form a knife-like edge which will abraid insulation. When the ends are properly reamed, they appear as shown in Fig. 6-II, but if they are screwed together too tightly, they may turn up

as at I, defeating the thing that reaming should accomplish. Where no other tool is available, conduit can be reamed by hand with a half-round file.

For cutting conduit the best tool is a hack-saw. Pipe cutters are frequently used, but leave a large bur on the inside of the conduit, which takes time to ream out. While cutting, the conduit should be held in a vise. On jobs where there is a great deal of conduit to cut, the installation of a motor driven cold-cut-off saw, such as used for cutting structural steel and rails, will prove economical. A rapidly rotating steel disk, without teeth, cuts the pipe. Water must be sprayed on the disk to keep it cool.

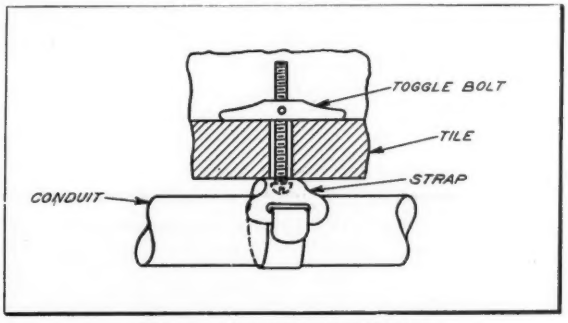


FIG. 7. CONDUIT TOGGLE BOLT

In installing exposed conduit runs where there are several conduits in the run, it is usually better to carry the erection of all of them along together, rather than to complete one line before starting the others. If all are carried along together, it is easier to maintain all of the ducts parallel, particularly at turns, and the chances are that the job will, thereby, look better.

For supporting conduit on hollow tile, a hanger, as shown in Fig. 7, is used. With it, only one hole is necessary through the tile, which is considerably weakened by the 2 holes and plugs close together that are necessary for a pipe strap. The flexible metal strap is bent around the pipe and through the slot after the conduit is in position.

Conduit can be supported on surfaces with pipe straps. On wooden surfaces wood screws secure the straps in position. On masonry surfaces, wood screws turning into wooden plugs, driven in holes in the surface, or turning into lead expansion anchors, can be used. Wooden plugs are apt to be unsatisfactory,

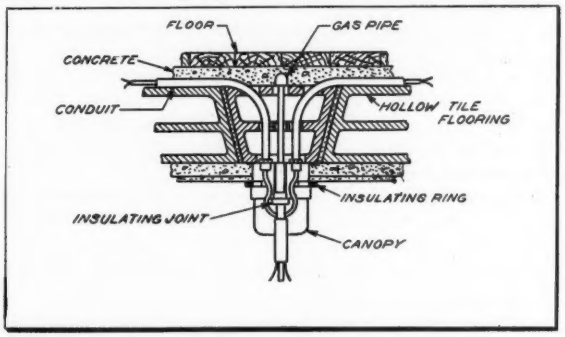


FIG. 8. CONDUIT IN FIREPROOF BUILDING

because no matter how well seasoned a plug appears to be, it will usually dry out some and loosen in the hole. Where conduit is carried on the flanges of I beams, one of the many commercial clamps can be used. Conduit can also be supported on an I beam by first clamping a wooden block to the beam and then securing the conduit to the block with pipe straps.

Conduit in fireproof buildings is usually carried over and is supported by the floor beams, Fig. 8, when carried within the floors. When necessary, the terra-cotta fireproofing is channeled to receive it. In vertical run in walls or partitions, the fireproofing is either channeled for, or built around, the conduit, which is held in place prior to plastering with cut nails or pipe hooks.

Conduit in concrete buildings—much of it at any rate—should be installed while the building is being

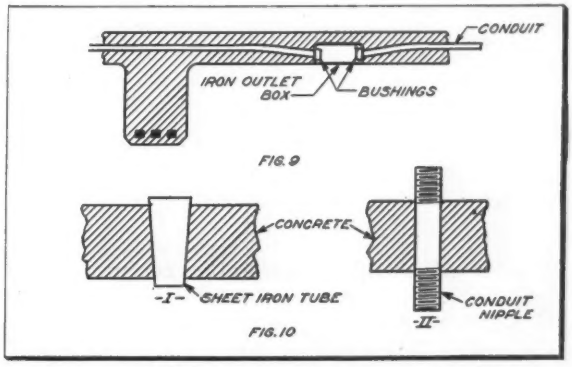


FIG. 9. CONDUIT AND OUTLET BOX IN CONCRETE
FIG. 10. METHODS OF GETTING THROUGH CONCRETE

erected. The outlets and the conduit between outlets should be attached to the forms and the concrete can be poured around them, as shown in Fig. 9. Where several conduits are to pass through a wall, partition or floor, a plugged sheet iron tube, Fig. 10-I, should be set in the forms to provide a hole for them in the concrete. Where a single conduit is to pass through,

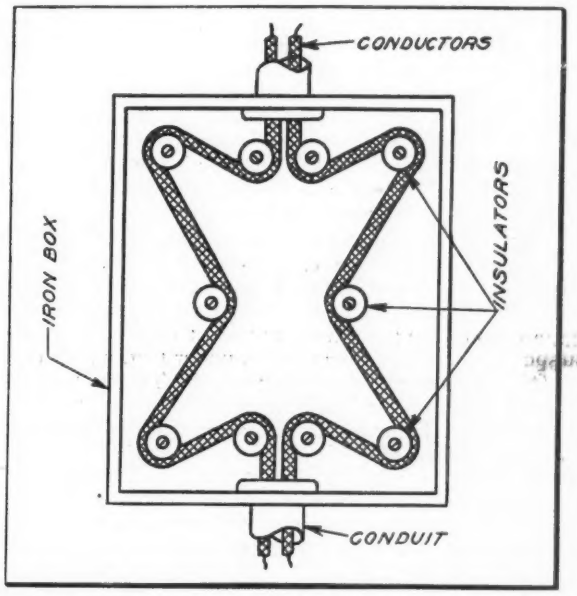


FIG. 11. SUPPORTING CONDUCTORS IN A VERTICAL CONDUIT RUN

a nipple, (Fig. 10-II), can be set in the forms. A running thread should be provided on the nipple so that the adjacent conduit lengths can be connected to it.

Conductors in vertical conduits must be supported within the conduit system, as indicated in the following table:

No. 14 to 0 inclusive every 100 ft.
00 to 0000 inclusive every 80 ft.
Above 0000 and to 350,000 c.m. inclusive every 60 ft.
350,001 c.m. to 500,000 c.m. inclusive every 50 ft.
500,001 c.m. to 750,000 c.m. inclusive every 40 ft.
Above 750,000 c.m. every 35 ft.

The following methods of supporting cables are recommended by the Underwriters:

1. A turn of 90 deg. in the conduit system will constitute a satisfactory support.

2. Junction boxes may be inserted in the conduit system at the required intervals, in which insulating supports of approved type must be installed and secured in a satisfactory manner so as to withstand the weight of the conductors attached thereto, the boxes to be provided with proper covers.

3. Cables may be supported, Fig. 11, in approved junction boxes on 2 or more insulating supports, so placed that the conductors will be deflected at an angle of not less than 90 degrees, and carried a distance of not less than twice the diameter of the cable from its vertical position. Cables so suspended may be additionally secured to these insulators by the wires.

Other methods, if used, must be approved by the Inspection Department having jurisdiction.

HEAT AND COLD INSULATION*

Testing Insulation

By H. W. Prentis, Jr.

REALIZING the necessity of securing reliable information, the company with which I am connected, established a fully equipped heat transmission testing station some 6 or 7 yr. ago, with experienced engineers in charge. This plant, located at Beaver Falls, Pa., has been kept in almost constant operation. A mass of data has thus been obtained relative to the heat conductivity, not only of insulating mediums of all kinds, but of building materials—stone, concrete and brick as well.

This comprises a well-insulated room, approximately 25 ft. long, 6 ft. wide and 8 ft. high, and a 3-ton refrigerating machine. The testing apparatus proper consists of 15 ft. of 8-in. pipe, blanked off at each end with a cap and set up on wood supports inside the testing room. There is a ½-in. inlet at the bottom of the pipe at one end and an outlet of the same size at the top of the pipe at the other end, through which hot water is pumped. One of the supports is higher than the other so that the pipe slopes upward, preventing air pockets from forming. When covering is being tested, the entire 15 ft. of 8-in. pipe is covered with the material under test. In testing the loss from bare pipe, the pipe remains uncovered.

Two calibrated thermometers are set in the pipe 10 ft. apart, 2.5 ft. from each end—so that the bulb of each thermometer comes about at the center of the pipe. The thermometers are set at that distance from the ends of the pipe in order that it may be carried on supports outside of the portion under test, which is the 10 ft. between the 2 thermometers. The temperature of the room, which is cooled by brine pipes hung along one side, is indicated by 2 Fahrenheit thermometers, one on either side of, and hanging about on a line with, the 8-in. pipe. A baffle plate, extending from 6 in. above the floor to within 6 in. of the ceiling, is placed in front of the coil to prevent direct radiation and to assure circulation and uniform temperature throughout.

The procedure in making tests is as follows: The refrigerating machinery is started and hot water is pumped through the 8-in. pipe. After constant conditions are obtained, the hot water is continually circulated through the pipe and the room held at whatever temperature is decided on for 24 to 48 hr. additional, before readings are taken. During the whole of each test, the temperature of the testing room is held constant and the temperature of the ingoing hot water, and the amount of flow kept as nearly uniform as possible. The 2 hot water thermometers and the 2 room thermometers are read every 15 min. through windows in the test room, and the hot water flowing through the pipe caught and weighed with great care. The hot water outlet thermometer, of course, gives a lower reading than the inlet thermometer, this difference being due to the heat which is lost by the hot water in passing through the test area, namely, the 10 ft. of pipe between the 2 thermometers. All the water is brought in contact with the bulbs of both instruments by means of a series of baffles in the pipe.

At the expiration of each test the average difference in temperature between the inlet and the outlet thermometers in the pipe, and the average difference in temperature between the hot water and the air in the testing room are determined, and the number of pounds of hot water flowing in 24 hr. ascertained. If bare pipe is being tested, the surface area of the 10 ft. between the 2 thermometers must be determined; if covering, the area at the mean circumference.

From these data the total loss of heat (i. e., the amount of heat transmitted) in 24 hr. through the pipe surface, either bare or covered, as the case may be, between the 2 thermometers, is obtained by multiplying the number of degrees loss in temperature of the hot water in passing from one thermometer to the other, by the number of pounds of water flowing in 24 hr., and then multiplying this product by the amount of heat required to raise 1 lb. of water 1 deg., which is 1 B. t. u. This result, divided by the area of the bare pipe in square feet, or by the area of the covering at the mean circumference, as the case may be, gives the amount of heat loss per square foot in 24 hr. By again dividing, this time by the average number of degrees difference in temperature between the air and the hot water, there is obtained the loss of refrigeration through the bare pipe, or pipe covering, whichever is being tested, per square foot, per degree difference in temperature for 24 hr.

Since the heat transmission through any insulating material of uniform structure is in inverse proportion to its thickness, the results obtained may readily be reduced to the standard basis, namely, per square foot, at the mean circumference, per 1 in. thickness, per degree difference in temperature for 24 hr. This is accomplished merely by multiplying the transmission through the covering per square foot at the mean circumference, per degree difference in temperature for 24 hr. by the thickness of the covering in inches. This

*Continued from page 746 Aug. 1 issue.

unit transmission, once determined for any given form of covering, the transmission through covering of the same description of any thickness can be readily calculated. Moreover, by this means the relative efficiency of 2 different coverings of different thickness can be compared on a common basis.

Desirable Covering Thickness

USING the transmission values that we have obtained for bare pipe and a certain steam covering known as Nonpareil High Pressure Covering, as a basis, let us take a concrete case and see exactly what thickness of covering should be used if the line is to be properly insulated from the standpoint of economy in operation.

Let us assume that there is a power plant in Topeka, Kansas, having 800 ft. of 6-in. steam pipe, carrying a pressure of 150 lb. to the sq. in. All the piping is inside the plant. The average temperature of the building the year round is, say, 60 deg. F. Under these conditions the heat lost from the bare pipe would be 21,705,240 B. t. u. every 24 hr. Using Kansas steam coal with a heating value of 11,000 B. t. u. to the pound and assuming that 60 per cent of its heat is used in generating steam, 3288.6 lb. would be required to offset this daily loss. In a full year 600.6 tons of coal would be thus wasted. If the cost of the coal is $2 a ton, the actual money loss from the bare pipe would amount to $1201.20 annually.

By insulating this line with Nonpareil Covering, standard thickness, that is, 1 3/16 in. thick, the heat loss would be reduced to 3,061,638 B. t. u. every 24 hr., to offset which would require 84.6 tons of coal a year, which would cost $169.20. Thus the saving resulting from the application of the covering would be the difference between $1201.20 and $169.20, or $1032 a year. The cost of installing the covering would be $320. It will be seen, therefore, that the standard thickness covering would actually pay for itself in less than 4 mos., or, in other words, the investment would yield a return of 322 per cent the first year.

Now let us see what Nonpareil Covering 2 in. thick would save if applied to the same line. The heat loss would be reduced in this case to 2,019,135 B. t. u. every 24 hr. The coal that would have to be burned to offset this loss would be 55.8 tons per year, which at $2 a ton would cost $111.60. Thus the additional saving resulting from the application of the 2-in. covering instead of the standard thickness covering would be the difference between $169.20 and $111.60, or $57.60 a year. The cost of 2-in. covering would amount to $567, $247 more than the other. Hence the added investment of $247 would yield a return of fully 23 per cent a year and at the same time, you would secure drier steam. The heavier covering would, in all probability, last longer in service. The rate of depreciation would vary, of course, in different plants, depending on the character of the line, whether it was exposed to serious deteriorating influences, etc., but under ordinary service conditions it would certainly appear that the additional investment for the heavier covering would be justified.

Let us now see whether still thicker covering, viz., 3 in. in thickness, made up of 2 layers of 1½ in. would pay. Using the same process of calculation, we find that covering 3 in. thick would show a saving of $29.60 a year over the saving effected by covering of 2 in. thickness, but its cost applied would be $351 more. Hence the additional investment would yield a return of only 8 per cent per annum. Allowing for depreciation and interest on the investment, it can be seen that this would hardly be a paying proposition.

The law of diminishing return has come into play so that under the conditions which we assumed, the 2-in. covering will be about as thick as could be used to advantage. Further calculation might show that a thickness somewhere between 2 in. and 2½ in. might pay.

Now, according to my understanding of the situation, the cost of coal in the far western end of Kansas is considerably greater than it is in the eastern section. One engineer informed me that it would average about $4 a ton out there. Assuming that our 800 ft. of 6-in. line is located in some town where the cost of coal does run up to that figure, let us see whether this alters the situation as far as the insulation is concerned. When we figure the proposition out, here is what we find:

By spending $247 more for 2-in. covering instead of covering of standard thickness, you would actually save $115.20 a year additional, or, in other words, the added investment would yield a return of 46 per cent per annum—as compared with 23 per cent in the case of $2 coal.

Covering 3 in. thick would show an additional saving over 2-in. covering of $59.20 per year, which means a net return of 17 per cent on an additional investment of $351. If we assume that the life of the 3-in. covering is 10 yr., this would mean that you would save almost $600 additional in that period of time over and above the saving in coal, which would be effected in the same period by 2-in. covering. As I said before, the local conditions obtaining in the particular plant in which the covering is to be installed, would here have to be taken into consideration in determining whether or not the 3 in. would actually be a paying proposition or not. It looks as if it would be with coal at $4 a ton.

In these illustrations I have used Nonpareil Covering as a basis, since I can speak regarding its efficiency and its cost with authority, but, of course, the same line of reasoning would be equally applicable in the case of any other high grade covering of known efficiency.

It can be shown in a similar way how abundantly it pays to apply covering of adequate thickness to brine, ammonia or ice water lines. The data obtained at our testing plant bearing on this subject, have already been collated and made available in such form that it can be used readily by anyone. The information relative to steam pipe and boiler covering will also be placed before the public in the near future.

It is earnestly to be hoped that it all may react to the advantage of steam users everywhere by encouraging the application of scientific management to the art of heat insulation.

PLANS ARE BEING MADE by the officers of the United States Bureau of Mines to take charge of the removal of the executive offices and testing station from the old Allegheny Arsenal property to the new site for the bureau's station adjoining the Carnegie Institute of Technology in Pittsburgh. In the new site the bureau will have opportunity for the erection of a modern plant in an ideal location. The school of applied science of the technical schools will work in harmony with the bureau of mines and the students will have the advantage of the tests and practical training in mining engineering.

SHAVINGS, WHEN used in conjunction with coal as a boiler fuel, have, according to L. F. Murphy (N. E. L. A. Bulletin, March, 1913), a heating value of from 45 to 50 per cent of an equal weight of coal.

AN INDUCED-DRAFT PLANT

German Electric Plant Secures Excellent Results in Coal Consumption by Use of Artificial Draft

By Alfred Gradenwitz

INDUCED-DRAFT plants possess a number of advantages over the natural draft of brick chimneys; apart from a more complete utilization of the waste gas heat, which allows an inferior grade of fuel to be used, the intensity of the draft can in fact be increased considerably, thus enabling large quantities of steam to be raised during the short periods of maximum load, without exceeding the dimensions corresponding to the average load on the boiler plant. Artificial draft further provides a satisfactory solution of the problem of increasing the intensity of draft in the case of an extension of the engine and boiler plants, or the installation of economizers. Artificial draft is practically independent of weather conditions and allows the production of smoke to be reduced to a minimum, thus protecting neighboring buildings from the smoke and soot nuisance. It finally avoids the objectionable effects of chimneys on the architecture of a powerhouse.

Artificial-draft plants have either direct or indirect draft. The latter comprises a fan which by means of a nozzle, forces an air current of a certain pressure into a specially shaped outlet pipe, thus producing in the latter a partial vacuum, so that the waste gases are sucked out and discharged into the atmosphere. The action of a direct-draft plant is based on the principle that the waste gases pass through an induced-draft fan, forcing them through an outlet stack into the open air.

The municipal electric works of Lichtenberg, near Berlin, contains an especially interesting induced-draft plant of considerable dimensions. This is calculated for 4 large double boilers of which only 3 have, however, been so far installed. The 3 Steinmueller boilers have been fitted with 3 superheaters each of 1249 sq. ft. heating surface, so that the steam at a pressure of 190 lb. gage reaches a temperature of 622 deg. F. The heating surface of each boiler is 3767.4 sq. ft.; the normal output, viz. 19,300 lb. of steam per boiler, can be increased to a maximum of 23,200 lb., and temporarily even to 27,000 lb. The feed water, before mixing with the boiler contents, is preheated by 3 economizers each of 239.2 sq. ft. heating surface, to a temperature of about 212 deg. F. Each boiler with a consumption of 3310 lb. coal (27,776 B. t.u. heating value) is charged by 6 mechanical stokers.

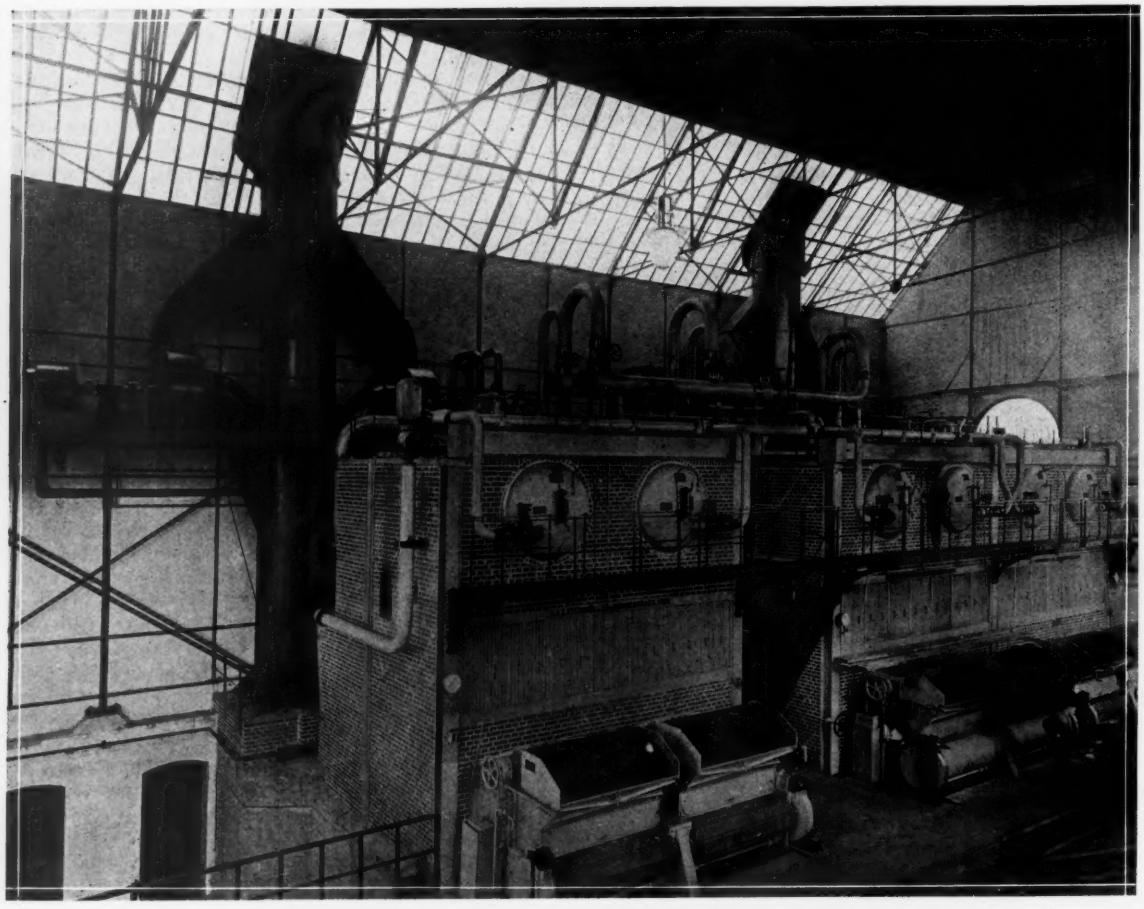


FIG. 1. DAGUA INDUCED-DRAFT PLANT AT LICHTENBERG ELECTRIC WORKS

The Dagua induced-draft plant installed by Messrs. Danneberg and Quandt, Berlin, shows a number of novel features. Two induced-draft fans are connected with each outlet stack, so that each double boiler can be served by a special fan. Reversing flaps are fitted in the outlet stacks and slides in the induction draft fan, so that the artificial draft plant can be thrown out of work as the load drops below 500 kw., when natural draft again comes into action. Such fluctuations will, for instance, occur during intervals between the working hours of the large electricity consumers. This allows the production of steam to be adapted most perfectly to the actual requirements of operation.

Induced-draft fans are of special design and fully suffice to deal with the circulating waste gases. The bearings are protected against overheating by an efficient system of water-cooling. The power used up by the induced draft plant is rather less than 1 per cent of the engine output; the 4 induced-draft fans are driven by direct-coupled electric motors, 2 of which are 3-phase and 2 direct current shunt-wound motors of Siemens-Schuckert Werke of Berlin.

The engine-room at present contains 2 generating sets, while a third set (of an output of 3000 kw.) has already been ordered. Each of the 2 existing generating sets comprises a 1500-hp. M. A. N. steam turbine, coupled to a Siemens-Schuckert 3-phase generator with built-on exciter. The shafts of the 3-phase generators are connected to the turbine shaft by rigid couplings. The high-tension 3-phase current of 6000 volts and 50 cycles is reduced to a tension of 220 volts for light and power purposes. The output of each generator with 3000 r.p.m. is 1200 kw. Three switch-columns arranged between the 2 generator sets allow the machines and the switchboard (in front of the latter) to be controlled by a single operator. About 1140 kw. are used for feeding the lighting system, which comprises about 10,000 incandescent lamps, and about 3000 kw. for power purposes.

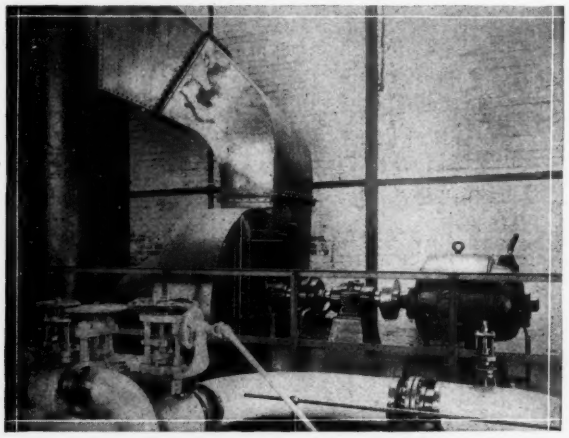


FIG. 2. DAGUA INDUCED-DRAFT FAN DIRECT-CONNECTED TO 3-PHASE MOTOR

Actual tests have shown the boilers to produce 7.3 lb. of steam per sq. ft. heating surface an hour, each pound of coal raising 9.75 lb. of steam. The steam consumption per kw.-hr. is 13.8 lb. at a full load, while under usual conditions with an average day load of 1050 and a night load of 270 kw. 2.2 to 2.42 lb. of coal are required to produce 1 kw. per hour.

FOREIGN DEVELOPMENT IN THE POWER PLANT FIELD

Heating and Ventilation of Schools; Fissures in Steel Boiler Plates

By J. H. Blakey

IN the Revue Industrielle for Dec. 8, M. F. Andrel discusses the subject of heating and ventilating schools, the importance of which is not questioned. Large sums of money are devoted to the education of children, and by a short sighted policy we fail to get "value received" in many cases because the children are breathing an atmosphere in the schoolroom which makes the proper functioning of nerve and brain impossible. Inattention, apparent stupidity and general bad behavior are often considered as being due simply to natural depravity, when in reality they are to be attributed largely, if not entirely, to defective ventilation in the schoolroom. All this has been said before, but it will bear repetition.

The problem, however, is difficult, and has not yet been satisfactorily solved. M. Andrel suggests that the heating and ventilation of schoolrooms should be so arranged that there will be a complete change of air once or twice an hour in gymnasium rooms, private offices, stairways and corridors, 3 or 4 times in laboratories and class rooms, and 5 times in toilet and dressing rooms. This does not mean a flushing of air so many times an hour, but that the amount of air passing hourly through a class room, for instance, should be 3 or 4 times the cubical contents of the room. Of course these figures may be modified where rooms are extra large or small for the number of children; a calculation may be made on the basis of allowing 400 cu. in. of fresh air a minute for each person.

Ventilation depending upon the action of the heating arrangement may be perfectly satisfactory in cold weather, and yet be quite inadequate in summer or even in mild winter weather. Cold air circulating along floors is often a cause of sickness and therefore any system of ventilation which makes this unavoidable should be supplied with means of suppressing such drafts during the time classes are in session. Class rooms are sometimes provided with 2 outlets for ventilation: one near the ceiling and one near the floor; experience has shown that it is better to have only one outlet and that near the floor, in order to avoid losing the heat which escapes by an upper aperture, carrying fresh air along with it before this has reached the pupils.

Introduction of fresh warm air near the ceiling when the outlet is near the floor frequently has the effect of producing a current of air around the ceiling, walls and floors without affecting the zone of respiration at all. Prof. Recknagel of Passau made some experiments under these conditions, and found the proportion of carbon dioxide near the ceiling to be 0.5 per cent, on the floor 1.03 per cent, and in the respiration zone 3.5 per cent. Therefore, wherever the fresh air inlet may be placed, care must be taken that the current produced proceeds right through the respiration zone; of course it need not and must not be strong enough to cause discomfort, but it is believed by some authorities that a perceptible movement of the air is exhilarating and desirable under all circumstances.

According to Pettenkofer each child produces on an average 50 calories of heat an hour; consequently

there need be no heating apparatus in class rooms if the temperature of the incoming air is kept at about 65 deg. F.

Arrangements must be made to keep the whole building at a temperature above freezing point during the time that school is not in session; this is necessary on account of the water supply, as well as to prevent the freezing of liquids in laboratories and class rooms.

The following temperatures are prescribed for some of the schools in Europe:

	Schoolrooms	Gymnasia	Stairs, corridors, toilet rooms and wardrobes.
Vienna	61 to 66 F.	59 to 64 F.	40 to 50 F.
Germany	62 to 64 F.	59 to 64 F.	50 to 65 F.
England	59 F.		50 to 65 F.
Switzerland	59 to 63 F.	50 to 54 F.	50 to 65 F.

At the Heating and Ventilation Congress held last year at Dresden, it was agreed that the best method of heating schools is by means of fresh air under pressure in combination with an outlet in each room. This system proves as satisfactory in summer as in winter on account of the fact that the incoming air in summer may (and should be) cooled below the outside temperature in order to remove the heat created by the children. Such a system will maintain a uniform temperature and a constant change of air without the opening of windows and doors, which is to be avoided on account of the distraction caused by outside noises. With this method also the proper humidifying of the incoming air becomes a simple matter; this point is often overlooked, but its importance has been insisted upon by medical men in recent years.

According to the Gesundheits Ingenieur, all the ventilation installations of the common schools of Dresden, which are dependent upon the difference between the interior and exterior temperatures for their action, experience a complete reversal when the outside temperature becomes higher than that inside, and when the 2 temperatures are equal the action ceases altogether. The remedy obviously lies in providing ventilating fans which will carry off the air when the outside temperature reaches or exceeds that prescribed for the schoolroom.

The question of the purification of the incoming air deserves some attention. The employment of air filters of cloth or some woven material has been tried and found unsatisfactory. For this reason air filters have been abandoned where they were in use, and in their place is used a spray of atomized water. This not only cleanses the air, removing all dust and floating matter, but also supplies the necessary moisture. The cooling of the incoming air in summer by means of a spray of cold water has proved refreshing and agreeable, and appears to be satisfactory in every way.

Summing up, the author says that the ideal ventilation is produced by a central heating installation in cellar or basement, with one or more outlets in each room near the floor, the incoming air being washed by a spray of water.

The Causes of Fissures in Extra Soft Steel Boiler Plates

EXTRA soft steel boiler plates require to be worked with great care, for they are fragile at temperatures varying from 750 deg. F. to a dull red heat. Hammering at these critical temperatures may produce the beginnings of fissures, there may be a certain permanent fragility in consequence of the hammering. These same cracks are developed without hammering in soft steel boiler plates: they may be caused by uneven heating, or by too quick cooling in cold water, after the rapid emptying of a boiler under pressure. This may also cause cracks in the rivets, as well as in the body of the plate.

In the 29th Bulletin of the Association of Steam Owners of the North of France, there is given another cause of the fissuring of rivets. In riveting boiler plates the rivets have a temperature of about 2550 deg. F.; the edges of the plates are brought to temperatures of great fragility, as indicated by the blue or yellow coloring of the metal. If the edges are well bent—that is, to the correct curve for the diameter—and applied exactly one against the other without space between, little injury may result; but in the case where this is not so, there is good reason to believe that permanent injuries are inflicted on plates and rivets.

Another explanation is suggested: in double riveting, the exterior plate, in contact with the gases of combustion, is impeded in its dilatation between the 2 lines of rivets, by those rivets which traverse the interior plate, which is at a lower temperature because of its contact with the water; there results consequently a shearing effect on the rivets and a tensile stress on the interior plate.

These logical explanations, although supported by experiments, cannot be absolutely confirmed; at present they can be regarded only as very probable hypotheses.

MISDIRECTED ENERGY

Final Success of the Producer Gas Plant

By I. H. P.

"NOW," said the visitor, laying down the paper, "I'd like to ask you a few questions bearing on this matter, if you have no objections. You've had a year's experience with the gas equipment, and you are well posted on steam and your comparisons ought to be unbiased and based on sound sense."

"Fire when you're ready, Gridley," said the engineer, lighting a fresh one, and glancing at the voltmeter to see if the boss's latest departure in voltage-regulators was still working.

"To begin with, then, you'd trade the gas apparatus right now for a good water-tube boiler and 4-valve engine, if you could, wouldn't you?"

"Nothing doing. Why, if I didn't like the gas, I'd quit this job and get a steam plant somewhere."

"Why do you like the gas better?"

"Because there's less work connected with the gas."

"It seems to me by your past experience, you've had nothing but work."

"I don't count that, only as experimental work. I think we have run the gamut and are practically at the end of the troubles."

"Well, wherein lies the difference in the amount of necessary work?"

"The washing of boilers and heater is by far the biggest item. We have scarcely touched our producers for a year now, and the lining is good for another year at least. There would be hardly any difference in the engine room; if any, the advantage would be with the steam on account of grinding of gas valves."

"How about these hot cranks."

"Say, we haven't touched those cranks for 6 months only to take out a liner once or twice, and to look at the pins. We have them bushed now with good babbit, and there's no reason, when properly fitted, why they shouldn't run as nicely as the best."

"Then there's your trouble with the choked gas main and the scrubber not long ago."

"All our own fault. All ells in big pipe should have cleaning doors and should be regularly inspected and cleaned."

"Don't forget the valve grinding."

"A mere bagatelle," said the other, "when you know how to go about it. The exhaust valves are the ones that get the worst, the inlet valves seldom need attention. When the valves are badly fitted they can be put in the lathe and the worst taken off, care being taken to keep the same angle as the seat. If the exhaust valve is not fitted, and is ground to a perfect seat, but still shows leakage, make sure the valve head does not warp when hot. The only remedy for this is a thicker valve-head, welded to the stem."

"Now, this business of muffling the exhaust, and how about all this jacket water going to waste, a large item in localities where water is scarce?"

"We are now using a device which solves both those problems; namely, a dry well 5 ft. in diameter, and 20 ft. deep, lined with concrete and concrete top pierced with an 18-in. hole for short stack to carry off the gases will kill all noise and provide space for jacket water to drain into, whence it is pumped by motor operated by float switch, to supply tank, leaving no waste whatever and if the discharge at the tank is fitted with a spray, the cooling in summer can be greatly increased. The scrubber water we let go to waste on account of the tar it collects."

"How about the lime in the cylinder jackets?"

"We have fixed that, also. The proper compound, based on a careful analysis of the water is introduced at intervals into the cylinders, and if engine is idle, the solution may be allowed to remain in the cylinder and drawn off before starting."

"Suppose in your case here, where you have 2 or more cylinders, one of the spark plugs went bad or you wanted to change it for any reason. Could you do it without shutting down?"

"Certainly. If the other cylinder would pull the load. Shut off the gas from that cylinder, prop the exhaust valve open, and remove the plug. When an engine has lain idle for several hours it is a good plan to take the plugs out and dry them thoroughly as they gather dampness in a way that would surprise you, especially if water is allowed to stand in the jackets as is the custom with some engineers."

"Suppose you had only one air-compressor and something went wrong with it, and you had no air in your starting tank. You would be up against it if your engine shut down for any reason, wouldn't you?"

"A careful engineer will try to keep out of a hole like that. We have foreseen just such a catastrophe as that, and provided for it as follows. Pipe a by-pass fitted with a check-valve, around the starting valve in the air line close to the cylinder, and after shutting off the gas on that side and letting the other cylinder drive the engine, the first cylinder will act as a compressor and charge back into the supply tank. This will answer if the engine is running. Of course, it's another story if it shuts down on you."

"We will assume that an equipment such as you have here has been idle 8 or 10 hr., with banked fires. In how short a time could the engine be started?"

"Thirty minutes is all that is necessary to blow up fires that will give good gas."

"What is good gas?"

"One that burns with a blue flame in air."

"Is there any danger from explosions in the producer room?"

"No, as the producers are protected by water-seals which will empty at the slightest explosion. One of the scrubbers is always protected by a lead gasket which on bursting would provide a large opening to the atmosphere. Of course, under certain conditions an explosive mixture may be formed, but the results are much less destructive than steam boiler accidents.

"It is a good plan on starting up, immediately after shutting down the blower to open partially the ash pit doors, so that, if there is any delay in starting the engine, any explosion, caused by the penned up gases passing and repassing the live coals on the grates, will be minimized. Then, again, an operator may forget to shut the fan off before he starts his engine. In this case the gas will be forced into the mixing chamber and air-intake, thus filling the engine-frame or the room with an explosive mixture."

"Will a producer-gas engine do continuous work up to its rated capacity?"

"I see no reason why it should not. Here, of course, our full load lasts only 5 or 6 hr.; the remainder of the 24 it varies below that."

"No trouble with your engine foundation?"

"Well, I should hope not, after all the precautionary measures taken to insure against the trouble. The footing was increased 50 per cent over the engine builder's plans; a 6-in. tile laid underneath to drain all surface water and 7 or 8 tons of railroad iron placed longitudinally and laterally in the concrete to strengthen and keep it from cracking. You can see for yourself how steady the engine runs. One day last week George put a nickel on edge on the frame to see how long it would stand and it stayed there till he needed it for car fare."

"Speaking of foundations, I have in mind a horrible example which supported a horizontal gas engine, and which rested on a very hard clay. There seemed to be an abundance of water in the clay, and the way that engine rocked and jumped around was a sight for sore eyes. The whole town seemed to rest on this slippery subsoil, as the pulsations were noticed easily 5 blocks away. Windows were rattled, freight car doors seen to move, and, believe me or believe me not, but the open door of an iron safe in an uptown office could be seen in constant motion if put in the proper position."

"How long did the engine last under those conditions?"

"They had considerable trouble with it and finally moved it to a new location, and at last reports it seemed to be running in good shape.

"Say! Is that clock right? Twelve forty! Great heavens! I'll have to get over to the hotel and get some sleep as I leave on that early train in the morning."

Going to the door with his visitor, the engineer exclaimed:

"Hello! Moon's up. Guess it's bright enough to shut off the street lights. Going to be a nice clear night out."

"Well, glad I met you. Goodnight, and good luck."

"Goodnight."

(The end.)

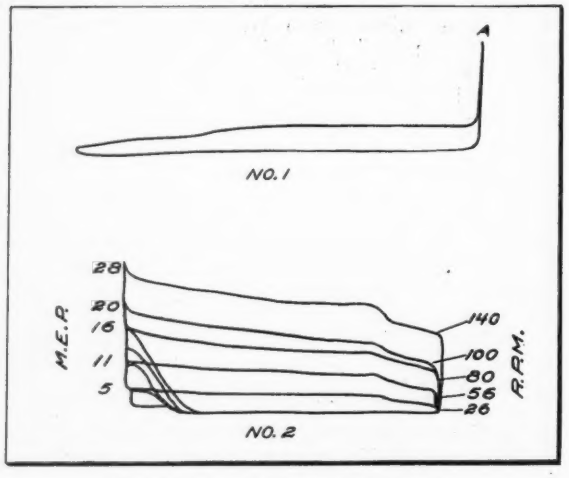
LETTERS DIRECT FROM THE PLANT

Cash Paid For Ideas Accepted. Sketches Desirable.
We Make The Drawings

WATER IN CYLINDER; M.E.P. AT VARIOUS SPEEDS

I AM showing a card which I have taken from a slide valve engine which after 30 min. of warming up would still get a head of water while passing the centers. The steam pipe to the engine had a valley in it and had an incline upward of 6 in. in 10 ft. of length, which collected water and could not be moved until the throttle was open and the engine started, even then taking 4 min. before the engine could be put up to speed, after which there was no further trouble.

I took the card when the engine was first started and it will be seen the high point of admission was caused by the water in the cylinder. It measures from 35 to 50 lb. while the steam line to start the engine only measures about 10 lb. This condition has been going on for over 10 yr. and yet no serious trouble has ever been caused for the reason that the slide valve lifts from its seat and relieves the water, which, were it of another type, would not stand the water so well.



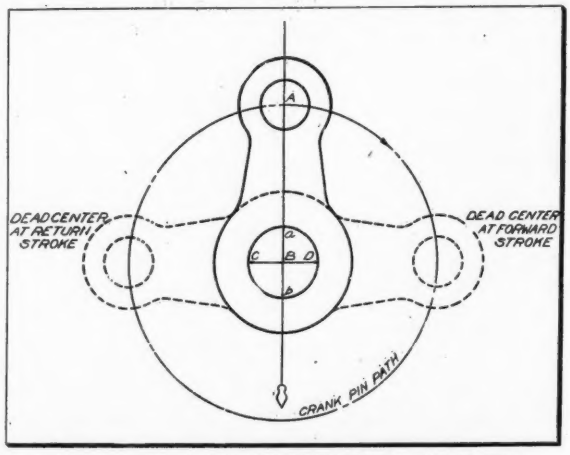
CARDS FROM SLIDE-VALVE ENGINES

Card No. 2 is from another slide valve engine, 8 by 10-in., running a 12-ft. ventilating fan. This one had no governor. I took this card to find out the required mean effective pressure for the specified number of revolutions or given amount of throttle opening. My method was to open the throttle and after the engine had attained a steady speed in each case, I took a card which shows the mean effective pressure required for each number of revolutions as designated. The load was the same in each case, except that with the increase of speed it of course displaced more hot air for heating as in all Sturtevant hot air systems. The numbers 5, 11, 16, 20, 28 are the mean effective pressures and 26, 56, 80, 100, 140 are the revolutions per minute. It will be noted that it takes an average of approximately 5½ lb. mean effective pressure to get each increase of 30 r.p.m. A. C. Waldron.

FINDING DEAD CENTER OF HORIZONTAL ENGINE

THERE are many methods suggested by different writers for finding the dead centers of horizontal engines; the most generally used is marking the crosshead, guide and flywheel with the help of a tram, and it is so well known that it is of no use to describe it here. But a method of finding the dead center employed by me and which has been in use for many years is as follows:

Keep the crank plumb as in the figure (full lines) so that the plumb line passes through the centers A and B of the crankpin and the crank shaft respectively and make 2 marks a and b in the same line on the face of the crank shaft with a center punch; then draw a line CD exactly at right angles to AaBb; and here,



PUTTING ENGINE ON DEAD CENTER BY MEANS OF A PLUMB BOB

too, make permanent marks at C and D. Now turn the engine so as to bring it to a dead center, and again throw a plumb line passing exactly through, and coinciding with the marks CBD; at this position the engine will be at dead center. By throwing the plumb line we can find any dead center whether at the forward or return stroke.

The advantage of this method is that whenever it is required to find out the dead center we have only to turn the engine and when it is nearly at the dead center we have only to throw a plumb line passing through the points CBD as stated above, and we get the dead center.

By the tram and flywheel method it is required to preserve the tram very carefully so that it does not bend, break or stretch, while by the latter method it is only required to have a fine thread and a weight (if plumb bob is not available) which can be got at any time and at any place at a moment's notice.

I invite the opinions of other readers about this and want to know whether this is correct for working or not. N. N. Bava-adam.

TROUBLE WITH CYLINDER OIL

THE article on page 659 of July 1 issue, Practical Engineer, "Trouble with Cylinder Oil," is, indeed, interesting as the writer has had a similar experience with various steam cylinder oils, 2 of which are mentioned in the article referred to, on a cross-compound condensing Corliss engine, 16 and 30 by 42 in., operating at 110 lb. steam pressure. But if W. L. had nothing more to contend with than a deposit of gummy substance resulting from the cylinder oil he used, he should consider himself exceedingly fortunate.

In our case the valves and cylinders were cut and scored to such an extent that it became necessary to rebore the cylinder and valve chambers; in order to prevent a recurrence of this difficulty we gave a detailed description of our operating conditions to 3 local oil merchants, and after carefully considering their respective suggestions, we accepted the one made by the Dearborn Chemical Co., who, accordingly, delivered us a trial barrel of its Fort Douglas XX Cylinder Oil, which, although slightly more expensive than the other oils we had been using, has proven a far more economical lubricant than any other oil we have ever tried, for the reason that we are using only ½ the quantity of this oil, that we were using of the others, and upon opening up our cylinders we now find the wearing surfaces covered with a fine coating of oil, and in perfect condition. In addition to these welcome features we find that little of this oil passes over into our boilers, whereas we had one continuous round of trouble from such deposits in our boilers while using the other cylinder oils.

In the practice of so-called extreme economy our management formerly insisted purchasing cheap supplies, limiting his analysis of existing conditions, to first cost only, with the aforementioned results.

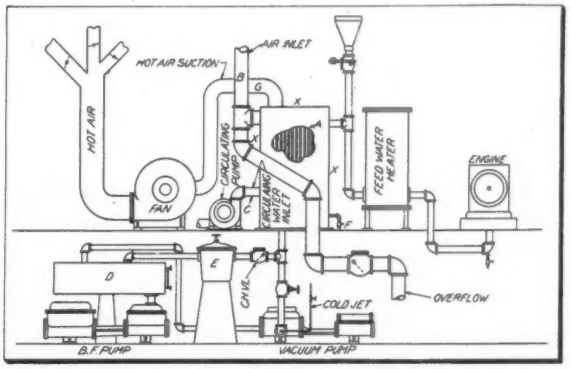
Now all supplies for the engineering department are purchased upon merit, a trial run is made and results are compared with cost; the engineer's report determines whether or not such supplies will be ordered again.

Needless to say that since the adoption of this system, we have had no trouble whatever, and now, instead of the manager and engineer discussing business matters over the phone—for obvious reasons—they meet in their respective offices, and part smiling, and with their hands perfectly relaxed. Al. Lee.

SURFACE CONDENSER

DIAGRAM shows a mongrel surface condenser. I doubt if there is another one in existence. I conceived the idea while having charge of a plant which had as part of its equipment, a Sturtevant hot air heating system. There was plenty of water near by, which could be used for circulating water and inasmuch as the engine was very much overloaded, I readily made use of the Sturtevant system to help out the engine, which it did amazingly, and cut the coal bill as well.

The engine would run condensing during 7 months in the year, because the Sturtevant system did the heating in winter and could not be used as a condenser. I had to install a vacuum pump and put a jet of cold water in the suction to help the vacuum. It will be seen by the cut that a sheet-iron box is made all round the heating pipes and is marked X and made to hold the water that flows around the pipes. This tank is kept full of water and overflows into pipe B. A small centrifugal pump supplies circulating water from a large brook passing the mill. It will be seen by the cut that when the engine is started the vacuum pump and circulating pump are started, the exhaust going through the feed-water heater thence into manifold heating coils A, around which the cold water is flowing, the condensed steam falling to the bottom into the vacuum pump, which puts it into the receiver, thence to boiler. The bucket trap E is in use before 7 in the morning. Live steam is put through pipes A for heating building. To heat the building, start



HEATING COILS USED AS A CONDENSER

fan engine, which draws cold air in air inlet, B, passes around hot pipes A and is drawn up the fan suction G and goes hot into the building. Before doing this, drip valve F should be opened to drain the tank, and if any time through the day it is desired to run condensing, all that is necessary is to stop fan engine, shut drip valve F and start vacuum pump and circulating pump C; all the hot returns from A go to D for feed water.

This system will carry 24 in. of vacuum every day, and if I were to put up another I would have the manifold A made of brass much thinner, so the water cooling effect would be greater, and I believe 28 in. vacuum could be had easily. The expense of installing this is small when compared with the saving in fuel and the additional power it gives due to the vacuum on the cylinder.

A. C. Waldron.

THE INDEPENDENT CONDENSER

THERE are many types of independent condensers, such as the surface and jet, which are subdivided into many forms of apparatus such as spiro-jector, barometric injector, piston and bucket pumps. It is with this class of condensing apparatus that most of the engine wrecks occur, and generally while shutting down the engine.

With the independent condenser there are many advantages to be gained over the dependent condenser and with a pump the amount of water handled can be varied by varying the speed and opening or closing the inlet valve.

Several engines may be connected to the same exhaust main and thus they may be started and stopped without starting or stopping the condenser, or several condensers may be operated on the same exhaust main, any one of which may be started or

stopped at will without lowering the vacuum on the exhaust main; but in such cases it requires 2 exhaust mains and 2 valves from each engine. The advantage gained by this system is readily conceived in all central power stations, where it is necessary to run one engine high-pressure while the rest are running condensing, and one outboard relief valve on the end of the condensing line serves all engines.

In starting an engine of this equipment the valve between the engine and condenser main is closed and the valve between the engine and the atmospheric main is open. It is preferable that this valve be automatic in operation to prevent accident to the engine in times of great confusion in the plants, when the wrong valves are always closed by some excited person. If this valve is automatic, as all the latest installed are, the engine is warmed up while exhausting to the atmosphere. When ready to start, with the steam valve all hooked up, the condenser is started and when there is sufficient vacuum in the condensing chamber, the inlet water valve is opened to allow just enough water to enter the condenser to condense the exhaust steam. More would be a waste of power required to handle it and a loss of temperature if the discharge water was used in the boilers.

Now that the condenser pump is working properly, the main valve between the condenser chamber and exhaust main is opened and the condenser is on the line ready for the engine. The outboard valve on this line is closed at all times except when the entire plant might turn high pressure from failure of the condensing apparatus. Close the valve from the engine to the atmosphere and open the valve between the engine and the condensing exhaust main. Frequently, when this is done, the engine will start from the vacuum in the low-pressure cylinder acting on the piston, but will do no harm as the generator will commence to build up the voltage on the field pole pieces which will hold the speed well down, just enough to keep the engine turning. The throttle is then opened to build up the voltage. In a factory plant, however, the engine will seldom start from the vacuum acting on the low-pressure piston, owing to the friction of the belts and shafting.

In some plants where there are many crooks and bends in a long exhaust main leading to the condenser, it is customary to open the outboard valve on the condenser exhaust line and start the engine exhausting to the atmosphere before the condenser valve is opened to this line. Then when the line has been freed of all water which may have accumulated in the main the valve leading to the condenser is opened, the condenser having been previously started. The exhaust steam rushes to the condenser chamber as the vacuum is being created in the main and the outboard valve will close automatically and the engine will then be running condensing.

With all jet condensing apparatus it is better practice to regulate the inlet water for condensing by the temperature of the discharge to the hot well, keeping in mind at all times the amount of load on the engine and the possibility of more which may come on.

Some engineers run the condensers with the discharge to the hot well as low as 80 or 85 deg., while I have seen the temperature of the inlet water in one plant as high as 110 deg. and discharging at 130 deg., owing to lack of proper cooling facilities during the warm month. I find the best temperature to be 100 deg. for the discharge to the hot well, as this does not allow the condenser chamber to become completely filled with water. In case the boilers prime with a jumping load, which would force more or less water into the condenser, the pump would not be running fast enough to handle the extra amount of water and the vacuum would be lost, especially if the vacuum breaker worked properly; it would open and admit air while the pump was discharging the extra amount of water, thus leaving no water to condense the steam. In this case, the forced injection valve must be opened and the pump speeded up to handle the extra accumulation of water. When the vacuum has been restored to its normal height the forced injection valve is again closed, as the inlet water will do the condensing.

Where there are several engines operating on the same exhaust line to the condenser, any one of them can be shut down at will by closing the throttle valve, and then without much hesitation close the valve between the engine and the condenser. Some care must be taken, however, unless the valve between the engine and atmosphere is an automatic valve. A leaking throttle valve would be admitting steam to the engine, which steam would have to be exhausted, and the pressure would accumulate in the exhaust pipe before a valve with a threaded stem could be operated.

Both condenser and engine could be taken off the condenser main at will without much risk from water getting into the cylinders, except the last engine, which if close to the condenser is apt to take water, for the reason that the instant the throttle is closed there is a vacuum created in the receiver as well as in the low-pressure cylinder and this vacuum is continually added to, as the engine keeps turning. If the condenser inlet valve has not been closed slightly, as the other engines were taken off the main, leading to the condenser, the slight increase in the vacuum as these engines were stopped would cause an accumulation of water in the condenser chamber, which, being at flood, would be drawn into the exhaust main and into the low-pressure cylinder before the vacuum breaker could operate and once the water had risen above the breaker vent, it would run out from weight instead of air rushing in. Only a small amount of water is needed in the low-pressure cylinder to punch out the head.

Therefore, it is always safest to close the valve between the engine and the condenser as soon as possible after shutting the throttle valve, and the condenser is then cut off from the exhaust main, the inlet valve and the throttle are closed and the condenser is stopped. Proceeding in this manner allows no time for water to be drawn into the low-pressure cylinder of the engine even if the condenser had stopped.

R. A. Cultra.

IN THE EFFORT to find some way of utilizing cheaper fuels for internal combustion engines, camphor has been tried and mixed in the proportion of 1 oz. of powdered gum camphor to 5 gal. of fuel. For the cheaper grades of gasoline, it is found that this gives a livelier engine, that the gas explodes quicker and that the engine starts easier. A slight saving in fuel has also been observed and so far as mentioned by the experimenter no bad effects have as yet been encountered, either in the engine itself or in the fouling of spark plugs. One user recommends powdering the gum camphor and dropping it into the gasoline tank, another one puts a chunk in the gasoline strainer when he fills the tank and lets it dissolve as the gasoline flows through. It is also found that this mixture of camphor improves the action of the gasoline blast for soldering outfits, gasoline stoves, blow torches and other devices.

HARD KNOCKS TO LOCATE

ONE cold morning I started up a 75-hp. Buckeye engine in a flouring mill. We did not run every day so winter got in a trick on us. There was a sudden stop after the engine started to move. The exhaust pipe had frozen up. After I thawed it out, and got the engine to full speed there was a strong knock.

I looked everything over when I shut down, and boxings seemed tight. I even looked at the piston head and found nothing. I ran several days this way, wondering all the time what was the matter, when I chanced to see oil working out in little streaks between shaft and disk arm. That told me my disk was loose on the shaft I took the pin out and put in a thin liner and with a heavy sledge set it tight. The knock went away forever.

On a small engine I found a puzzling knock once in the crosshead. The piston was kept tight with a pin and there was a little lost motion. G. H. Brough.

DO SOME INDICATORS LIE?

UNDER the above title I will show that some indicators do lie through no fault of mechanism, but a blunder of the workman whose duty it was to stamp the correct number on the spring.

I recently purchased my third indicator, which had been slightly used but apparently in every respect was as good as new and as is always my custom, I tested it out by comparing with one of my others which were known to be correct. My method of testing is to attach the indicators as shown in Fig. 3

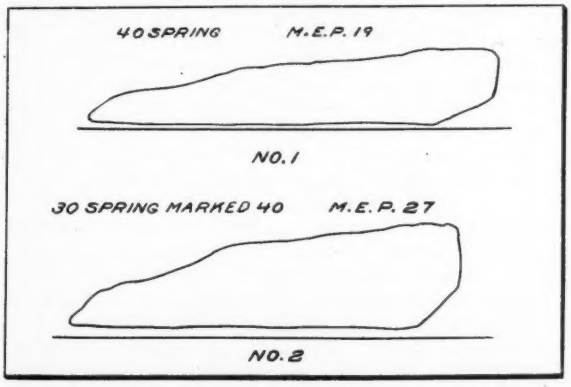


FIG. 1. CARDS TAKEN WITH SPRINGS MARKED 40 LB.

and take a card on each, at the same instant and stroke of the engine, which should look alike and the mean effective pressure of each card should be identical. I put a 40 spring in each.

My first set of cards is shown in Fig. 1 the first glance at these 2 cards is enough to see that they are not alike as No. 2 is much higher and has a mean effective pressure of 27 lb., while No. 1 shows only 19 m.e.p.

My first thoughts were that I had bought an unreliable indicator and paid a good price for it. I took a 30 scale rule and measured the mean effective pressure on No. 2 and it gave 19 lb., the same as No. 1 did, which at once told me that No. 2 spring was not true to its stamped number; so I replaced the 40 spring in No. 1 and put in a 30 spring. Now we have a 30 spring in No. 1 and a 30 spring falsely marked 40 in No. 2.

Cards Fig. 2 were then taken and both show 17 lb. mean effective pressure and are simliar except that one is longer than the other due to one drum being smaller than the other and lengthening the card. The new indicator is all right as long as we reckon its 40 spring as a 30 spring which it is.

This indicator was made by a reliable company but my sympathy goes out to the business men who have been deceived by it. If we allow ourselves to be deceived by the falsely marked spring it would

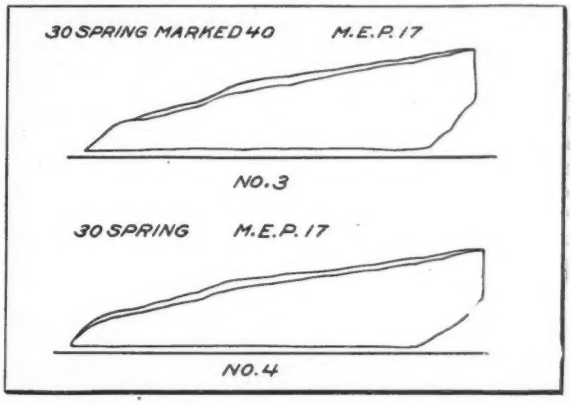


FIG. 2. CARDS TAKEN WITH 30-LB. SPRINGS

make the engineer think that he was doing more work than he really is, hence it will readily be seen why a falsely marked spring is an unending source of deception.

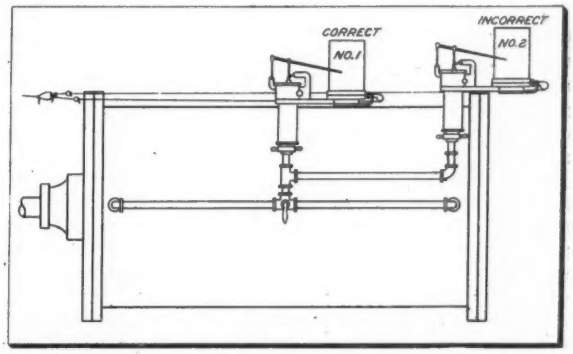


FIG. 3. INDICATORS CONNECTED FOR TESTING

I advise every engineer to test his indicator with some other engineer's indicator as a safeguard against such blunders as the above, no matter how reliable the manufacturer. W. A. C.

[The connections given in Fig. 3 cannot be considered correct for comparing 2 indicators as steam must travel farther to one than the other and the effects of condensation in the pipes will not be the same for both instruments.—Editor.]

BEING READY for any emergency is part of an engineer's duty. Recently an engineer was accompanying a much interested young lady through the Baldwin Locomotive Works, and she, pointing with her parasol to a large piece of work, asked, "What is that thing?"

"That," answered the gallant engineer, "is an engine boiler."

She was much interested in domestic economy, and inquired at once, "Why do they boil engines?"

"To make the engine tender," replied the versatile guide.

PRACTICAL TEST FOR LICENSE

IT is indeed a rare occurrence, nowadays, when one is able to pick up his technical magazine, steam journal, or even "house organ," and find nothing in regard to the license law, of this or that state.

I am a firm believer in the license, and am, perhaps, what some of the boys would call a fanatic on the subject, yet this is my first time to air my opinion through the medium of any paper, and though fanatical I may be, yet in another way, and from another viewpoint, I feel that I am really more reasonable than many of my brothers. Now, some who have succeeded by continual studying and memorizing innumerable formulas, questions and answers, etc., in securing the much prized license, have not been content with the mere fact of having it, but have proudly told the whole world that he who could not secure one, was mentally unfit, and should go hence, and speedily. This calls to mind an incident when I was a mere apprentice in that good old town of Cleveland, Ohio.

I was but 15 yr. of age, and had entered my apprenticeship when but 12. We had, as a recent acquisition, an assistant superintendent, who stood high on the ladder of the engineering profession—witness, his license—having, by hard study and a good memory, obtained a first class license, for somehow he had found 3 friends who also held licenses, and who had endorsed his application for one. And little I, who had been born poor but honest, and had left school at the age of 12, in order to learn to be an engineer, looked up to this great man in awe, and fairly groveled at his feet, in order to hear him expound his wonderful knowledge of this, my chosen profession. One night, after I had come to look upon him as the greatest living man, we had a great fire in one of the departments. At this particular time, I was serving in the generator room, which contained one 16 by 36-in. Greene, one 12 by 24, and a number of d.c. generators. It was my duty to keep them polished like the far famed "new pin," and at the expense of many bruises and blisters, I had them as clear and clean as mirrors. This night I had gone home, and the works were shut down, except the boilers, and the pumping department, when the alarm of fire was given.

My erstwhile great friend was still in the office, and he hastened to the generator department and vainly attempted to start my "monstrous" engine. I think, as I look back, that all he ever knew about engines was that they used oil. In shutting down, the regular operator had left the governor "dog," on the column, open, and governor was down on the "safety," and so "tappets" would naturally remain down, and the engine take no steam. So he (as I judged from appearances) took all the oil he could find, and poured it all over my beautiful steam chests and cylinder-heads.

I arrived about this time, in company with the regular operator, and this mighty man of knowledge and a first class license "jumped" him properly for not having used enough oil, as witness the engine refusing to go, owing to dry piston, which had stuck and frozen solid, and he was trying to get her loosened up, "but couldn't make it, he was afraid." The oil he applied to the exterior. This is the solemn truth, and can be verified. The regular man, to show his contempt, told me to "start her up" and busied himself with the generators. It was quite a struggle for me to lift the balls and turn the "dog," by myself, but I did it,—the "tappets" rising, I threw over the head end "toe," gave her steam, and joy of joys, "she moved, and seemed to feel the thrill of life along her keel." This gave me great joy, for now I was an engineer, but my joy was tempered by the fact that my idol had fallen, and was broken. Of course I got the swelled head, and wanted to break my apprenticeship, and go it alone, for was I not an engineer? But my daddy (and oh, how I then hated him for it) made me stick, and when I had lived another 15 yr. I blessed him for the favor.

In looking back over this, I find 2 strong points. One is, that a head trained to retain formulas and rules, though they may be all correct, without the practical hand to do the work is as likely to be a detriment to the community, as is the untrained laborer who takes charge of a large boiler plant. The other is, that too many of us have come to the conclusion that being able to oil an engine and open the throttle constitutes an engineer, and so have broken training. In justice to the good engineer who has been denied the benefits of a technical scholarship with his practical training, let me say that there are legions of him, who could handle any plant, yet are unable to convey their meaning in an explanatory way, owing to lack of education, and are therefore denied a license. I could not, I think, go today before a board and pass, without first reading up and memorizing a great deal that, though necessary to the examiner, has no bearing on the practical work in hand. I do not attempt, in general, to memorize a formula, merely testing my understanding of it, and having it handy in a reference library in case of need. And I have carried my license a long time, 19 yr. in fact, merely having it renewed from year to year. Of course there are also legions of good men who have a great memory, and can, and do, remember most of their formulas, and for them the license comes easy.

My remedy for the prevailing system would be this: Compel every man to carry a license—everywhere, and for any size, any type engine.

But be reasonable about it. Instead of compelling the well trained, practical man to take less wages in a field where no license is required, as nowadays, have each examining board keep on hand perfect engines—models—of different makes, and types, not assembled, and several boilers, set but not fitted. Have one sound boiler, one cracked, one with broken flues, or braces, (the one boiler could have all the defects). Then let each applicant bring a sworn statement from his employer that this man has been familiar with such machinery, as second or third man, for at least one year. (Always make the man responsible have a license.) Under the eye of the examiner let the applicant assemble correctly the different engines, naming each part, and finally inspect the boilers, making an inspector's report on them. This would show up a good, or a bad man, as well as the present system, and allow the technically untrained man a chance to compete with the trained man. Also it would demonstrate whether the technical man knew anything or not. Grant a license according to demonstrated ability, and be fair, as we should be. Many will say that this would leave the smaller plants without a licensed head. Not so. The second and third man from the other plants will fill these places, and even a clause could be inserted to grant the small plant man a chance to try for the license. The only objection to the small plant man is, that he seldom is acquainted with more than one type of engine. If the license man of today, and our brotherhoods would work more upon these lines, and show more fraternal spirit in the matter of aiding their professional brothers, the craft would indeed soon become the one which I viewed with longing, youthful eyes, some 25 yr. ago.

John Pierce.

Successful Kinks From The Plant

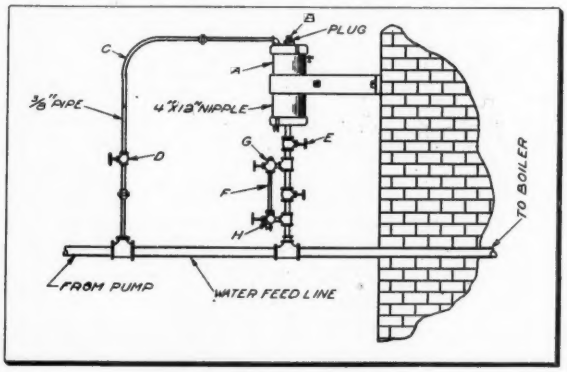
For Saving Time, Work and Trouble

Device for Feeding Boiler Compound

FEEDING of boiler compound in correct proportions with a certain regularity is in a great many instances something of a "hoo-doo" to the engineer. The regularity with which it is necessary to feed specific quantities of the compound, burdens the engineer or tender with but another troublesome and sometimes disagreeable task if there is no provision for doing it automatically.

Accompanying sketch is of an easily constructed device for the purpose of automatically feeding almost any kind of heavy liquid compound. It can also be manufactured out of the odd pipe fittings generally lying around the average boiler room or plant.

Compound reservoir A is simply a 4 by 10-in. nipple closed at each end by pipe caps, the upper one being drilled and tapped for a 1-in. pipe plug for the purpose of filling the reservoir. Pressure for equalization or operating the device is secured through the ⅜-in. pipe C, leading from the feed line pipe to the top of the



BOILER COMPOUND FEEDER

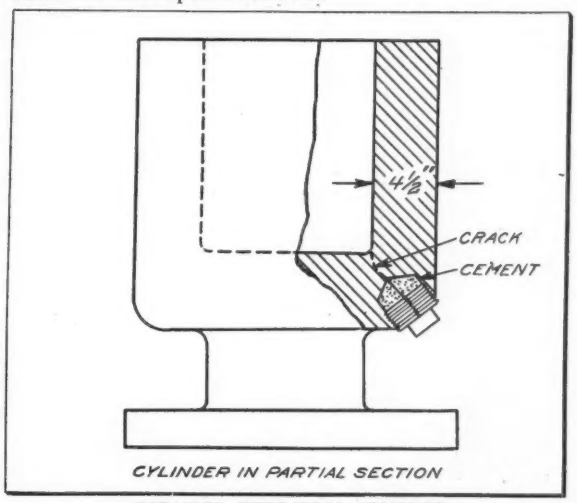
reservoir A. The valve D should be located at some accessible point as it is closed with the valve E when filling the reservoir. Leading from a hole tapped into the lower pipe cap, pipe tees and nipples are so arranged as to carry the compound through the water glass F. In this manner the amount of compound supplied continuously to the boiler is always under observation, and when empty the device is readily and easily filled without disturbing the water or sight feed glass valves G and H, which when once set and adjusted will automatically control and regulate the amount of compound entering the boiler.

F. W. Bentley, Jr.

Repairing a Hydraulic Cylinder

WE had a hydraulic press in the shop that one day sprung a leak in the cylinder. It happened at a most inopportune time for there was lots of work to do and every idle day of the press meant over $100 worth of work delayed. A new cylinder could not be had in less than 3 weeks.

The stroke of the press was upward, in a vertical direction, the cylinder was closed and cast solid at the bottom and it was at the corner in the bottom where the crack was supposed to be though no crack was visible and its location was determined only by the leak of oil which spurted out when the gage got up to 3000 lb. per inch. No ordinary plugging would hold, we knew, but the engineer offered a suggestion which was accepted and acted upon. It worked so well that we were able to use the press until a new cylinder came. A description follows:



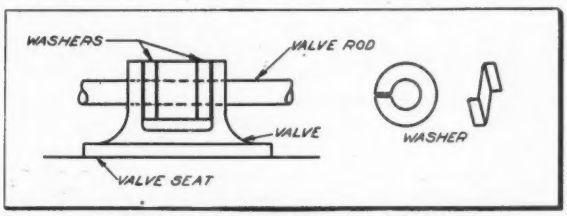
REPAIRED HYDRAULIC CYLINDER

The oil spurted out in a line 1½ in. long. Centered on this line we drilled and tapped for a 2-in. pipe plug, taking care to get first class, full threads. A heavy plug, also with good threads, was selected. In the hole below the part to be occupied by the plug was rammed Portland cement, mixed stiff, and enough of it so the plug compressed it. The plug, well red-leaded, was screwed in as tightly as 2 men on a wrench could put it.

D. A. Hawpson.

Pump Valve Repair

I WAS called to a boiler room to look at a Dean duplex boiler feed pump. The fireman, who is also engineer, told me that the pump was worn out. It was all loose and he had told the superintendent to get a new pump.



WASHERS USED TO REPAIR PUMP VALVE

I took the cover off and put thin washers on the rod to make up for the lost motion of the valve gear, put on the cover and the pump worked fine.

John Aubrey.

Questions Answered and For Answer

Expert Help When In Trouble. If You Want Quick Answer Enclose a Stamp

Questions and Answers on Everyday Practice with Hydraulic Elevators

HOW much water and air should be carried in the pressure tank?

A. It should be carried ⅔ full of water and ⅓ full of air.

2. What occurs when the tank is more than ⅔ full?

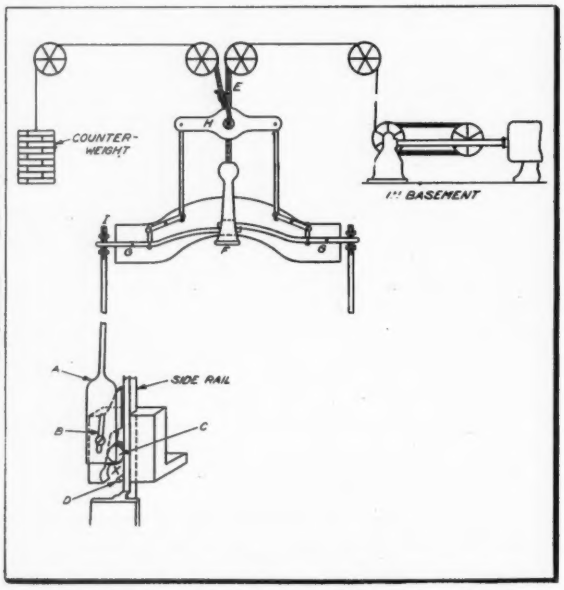


FIG. 1. OUTLINE OF HYDRAULIC ELEVATOR SHOWING SAFETY ENLARGED

A. The higher the water level in the pressure tank, the less volume of air to expand, and when the car is started, the pressure drops more suddenly; as, for instance, if there was no air and the pressure tank solid full of water, being nearly noncompressible—the instant the pilot valve was opened, the pressure would drop to zero.

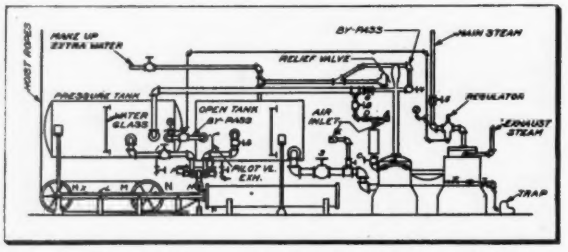


FIG. 2. AIR PUMPING ARRANGEMENT FOR HYDRAULIC ELEVATOR

3. What would happen if pressure tank was less than half full and the rest was air under pressure?

A. In many pressure tanks the supply pressure for the elevator cylinder is taken from the side of the pressure tank, about ⅓ from the bottom, and it is obvious that if the water got below the top of this pipe, the air—which has a pressure of from 60 lb. to 250 lb., and in some cases much more—would rush in through the pilot and main valve and against the lifting plunger and bounce the car, and if it had safety like Fig. 1, it would set them solid.

4. How would you put air into the pressure tank?

A. There are several means. The best way is to have a Westinghouse air pump, which is the quickest way. Another way is to attach a pipe as shown in Fig. 2, having 2 check valves set as shown at A and a discharge valve at B. When the plunger moves it draws in air through check C, and when plunger reverses, check C closes and check D opens, and air is forced through B to the pressure tank. This can be left in operation while pump is in service. It sometimes takes several hours to pump one inch of air. After sufficient air is in, close valves B and C.

Another way is to tap into the suction pipe of the pump and put a check valve on it, E, so it will draw in air at each stroke; but this air gets into the pump plunger and if care is not taken, will cause short strokes and churning, which is not the case with Fig. 2, because the pipe is attached above the plunger and the enlarged part of the pipe is partially filled with water all the time.

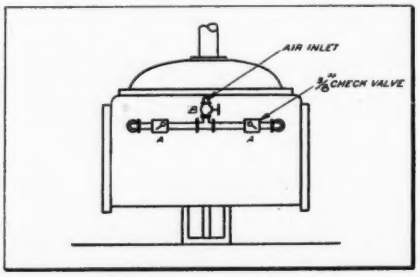


FIG. 3. AIR INLET ARRANGEMENT FOR ELEVATOR PUMP

5. How does air escape from a pressure tank?

A. Air escapes mostly from the top connections of the water glass around valve stem and glass stuffing box.

6. Suppose too much air was pumped in, how can it be let out?

A. By opening the top water gage valve and shutting the bottom valve, and opening the pet cock under bottom which will give direct connection from the top of pressure tank.

7. Suppose you had pressure tank ⅞ full of water and you wanted to decrease this quantity?

A. Do not open any pipe below water line, because this will only allow your pressure to drop and immedi-

ately your pump will automatically start and pump in as much as you let out. But instead of letting out water, you should pump in some air while making a few trips, and as you pump in air you will find your water level lowering.

8. How much water is desired in the open tank?

A. From ½ to ¾ full, because if much lower, the suction of the pump would draw air and the pump would hammer itself to pieces.

9. Suppose you entered your pump room and noticed that your water in the open tank was low, but yet not exactly dangerously low, what would you do?

A. You should first see where your water is in your pressure tank, because 10 to 1 you will find it high in there, because you have lost air. Now it is obvious that the proper thing to do is pump air into the pressure tank first, which will push the water level down, and since the air is replacing the water in the pressure tank, it will be noticed that water will rise in the open tank as long as you pump air into the pressure tank, hence there will be no need of extra water in the open tank, except possibly once a week.

10. What care should be given both tanks?

A. These tanks should be drawn off and cleaned out once a year, inspected, scraped and dried out, and 2 coats of red lead paint given each, because these tanks will pit and groove with the best of care.

11. How would you proceed to get things in shape to run again?

A. Put the manhole in place, and if you have a Westinghouse air pump, you can fill the open tank and pump water into the pressure tank ⅔ full; then start the air pump and pump air in until you have desired pressure. If you have no air pump, you can use your big elevator pump by having no water in your open tank; simply start the pump and it will pump in about 50 lb. pressure of air in pressure tank, which is about the best it can do. Now let water into the open tank, full, and the pump will pump this water into the pressure tank against the 50 lb. of air, and by the time the pressure tank is ⅔ full of water, it will have compressed this 50 lb. of air up to a pressure that your automatic pump regulator is set for and your pump should stop.

12. How are the plungers lubricated?

A. There is a good preparation made by the Lubron Co.—a thick grease, which can be put in a pail and with a steam pipe can be boiled for about 15 min. and is thoroughly mixed. This is put into the open tank and is pumped over and over, from one part to all parts, and thoroughly lubricates as well as forms a coating on the inside of the tanks and prevents corrosion to a large degree.

13. Elevator pumps sometimes pound heavily. How can you stop it?

A. By referring to Fig. 3, it will be seen that a ⅜-in. pipe connects both ends of one side of water end. There are 2 ⅜-in. checks, AA, set so the plunger can draw in air at each stroke through pipe B. This air is between the plunger and the top delivery valves, and makes a soft cushion instead of all solid water. At the same time, this gives you air in your pressure tank and is sometimes sufficient to make up air that leaks out.

14. What about condensation in pumps allowed to stand still too long?

A. All elevator pumps should be run with open drips and one common trap for them all, but be sure to put check valves on each end of drips so that when getting steam on the head end, it cannot blow through into the crank end and out through the exhaust.

15. What would you do to stop a bouncing plunger elevator?

A. This bouncing indicates air in the pressure cylinder and can be worked out by opening a small valve located below the stuffing box, at the top of the cylinder.

16. What causes the grating sound that is heard in elevators?

A. This may be due to several causes: First, see that the side rails are properly lubricated with a grease that can be put on with a paint brush; or see if the top shoes are not set out too far, or that the babbit is not worn off the shoe, or there may be a wire edge on the side rails, caused by running shoes iron to iron. Care should be taken, when the shoes are rebabbited, to file off this bur edge, or the shoes will soon need to be babbited again.

17. What does it indicate when the cylinder stuffing box persists in leaking in a plunger elevator?

A. It shows that the car is out of plumb, and the shoes are pushing to one side, which should be slackened on one side and tightened on the other side.

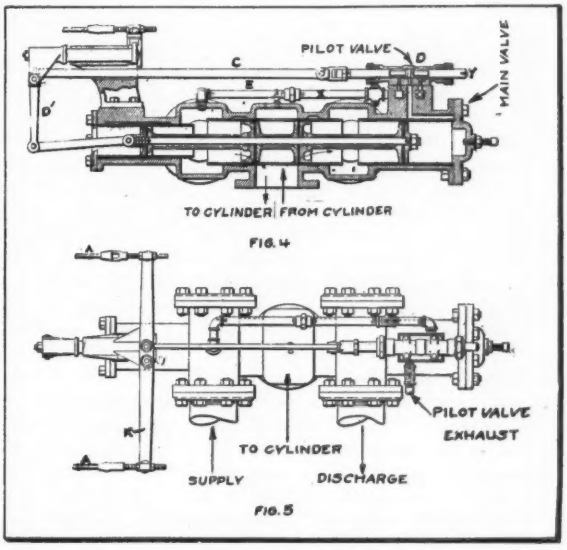


FIG. 4. CROSS-SECTION OF ELEVATOR PILOT VALVE
FIG. 5. PILOT VALVE SHOWING TILLER ROPES

18. What is the cause of hydraulic elevators creeping when the operating lever is central?

A. There are several causes: First, if the pilot valve D, Fig. 4, is not set properly, or if the tiller ropes A and A, Fig. 5, have not been taken up equally. But the most common cause is bits of packing from the cylinder packing getting into the 3 small port holes that lead from the pilot valve D to the main valve. This can be prevented by having a strainer like Fig. 6 attached to the supply E at X, which supplies pressure to move the main valve whenever the elevator will not stand in one place with operating lever in the center. First I advise taking out the 4 bolts in the pilot valve D, which will allow the pilot to be taken off, and in almost every case I have found bits of packing in the 3 ports; but before doing this, close both supply and discharge. If this does not remedy the trouble, you should start at the beginning and reset the valve and lever. First see that the whiffletree lever K, Fig. 5, is square across when the operating lever in the car is central. Now loosen the checknut that secures the pilot D to rod C

connection, and now, with car operating lever in center, open the supply No. 1 valve leading from pressure tank, and if the valve is set right, the car will not move; but if it should creep, you must take a screw-driver and put it in the end of pilot valve D at Y, Fig. 4, and screw it in or out, depending on which way the car is creeping, until the car stands still. If this will not stop it, you must have a new pilot valve, if it is a solid valve, because it has worn small and is leaking. This can be proven in 3 different ways: First, when the operating lever is central, put your ear down to the valve and you can easily hear the water going by it; second, disconnect the pilot valve exhaust, which is a ½-in. pipe coming from the back of the pilot valve and going into the open tank; or watch the lever D^1 that is connected to the main valve, and if it continues to move as if creeping, it shows that water is getting by the pilot valve D, and it

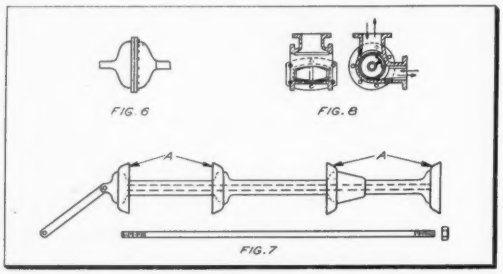


FIG. 6. STRAINER TO BE PLACED ON PILOT VALVE
FIG. 7. VALVE SHOWING LEATHER CUPS
FIG. 8. CHOKER VALVE

will move the main valve and the main valve will allow pressure to go into the lifting cylinder, and the car will move up or down when passengers are getting on, which has been the means of causing many accidents and much loss of life; and still another cause is the cup leathers in the main valve AAAA, Fig. 7. If they get scored by grit getting in, or leathers are worn small, water will leak by them from the cylinder and allow the car to creep down. It is only a 20-min. job to put in new leathers, and the length of time they will last is most uncertain, as I have seen some last 2 yr. and others not more than 3 months, because this is governed by the number of trips, the quality of leather, the inside condition of the main valve E, Fig. 4, cylinder wall, and the amount of sediment in uncleaned tanks.

19. What is the cause of cars going into the roof or on the bumpers?

A. This is due to the limit stops which operate the choker valve, Fig. 8 and H, Fig. 2, not striking soon enough or else the choker valve is leaking, which is a most common trouble.

20. How would you find the gear of a hydraulic elevator?

A. If the up travel of the car is divided by the stroke of the piston, it will give the gear of the car. This method is not necessary, because you can count the number of ropes that go up from the piston rod sheaves. If but one rope goes up, it is a 1 to 1 gear, because with 1 in. rise of piston, the elevator lowers 1 in., and if 2 ropes go up from piston rod sheaves, it is a 2 to 1 gear, and so on.

21. How would you proceed to get an elevator off the safeties if they were like Fig. 1?

A. It will be seen that as long as the lifting rope E remains tight enough to overcome the counterweight, the safeties will not take hold, unless by excessive bouncing the roller C will rise off from its resting pin D and hold up the car; but if the lifting rope E should break, lug F would drop down bearing against lever G G, and the counterweights would pull on crossbar H and cause the end of lever G to rise against the nuts I, which in turn would raise A, which has a shelf at the bottom, at X, upon which rests the safety roller C, and wedges it against the side rail with a powerful jamming pressure, and will suspend the elevator in the air. Both sides of the elevator are supplied with this same space left between nuts and lever at I. This is advisable, because through a slight drop of F, due to a sudden stop on the up trip, it would not raise A and cause safety to take hold. To get off the safeties, and if the lifting ropes E are slack, it is only necessary to tighten the lifting rope and slightly raise the car and A and roller C will both drop down and rest on pin D. The side rails should always be dressed with a file after the above, because the rails will be found to be cut by the roller C.

If the car travels by the top floor, it will be found that the slide M, Fig. 2, strikes N too late and N can be moved to the left until the elevator stops even with the floor, and if it goes below the bottom floor, N x can be moved to the right until the elevator stops even. They are attached to choker rod L which operates choker valve H at top and bottom limits at Fig. 2.

The layout as shown at Fig. 2 represents the hydraulic elevator system in common use.

22. How would you proceed to start up for passenger service?

A. First open suction valve 3, then bypass 4; now start steam pump valve 5. The pump will now be pumping from "open tank to open tank," after pump is thoroughly warmed up. Then open valve 6 and close valve 4, and now the pump will pump water into pressure tank until it gets pressure up to where the automatic Mason pressure regulator is set for, when it will close and pump is stopped. The elevator cannot be started yet; so next open valves 1 and 2, and everything is in operating order. To shut down, close valves in this order, 5-3-6-1-2 and open 4. A. C. Waldron.

Resistance for Motor

WE have a 2-hp. 115-volt d.c. shunt wound motor. We generate 220 volts d. c. Would you please give me formula for figuring the size of resistance coil to be placed in series with the armature? J. W. N.

A. The 2 hp. in 115 volts will require about 16¼ amp., allowing for 80 per cent efficiency and supposing the motor to run at full load.

To use up 105 volts with 16¼ amp. current, would require a resistance of practically 7 ohms. The method is, first, the watts required will be 746 for each horsepower, and for 2 hp., will be 2 times 746. Dividing this by the voltage 115 at the motor terminals, and by the assumed efficiency 0.8, gives 16.2. The volts to be used up in the resistance will be 220 — 115 = 105. The resistance required would then be 105 ÷ 16.2 = 6.42 ohms.

It would be necessary to have, therefore, a resistance with a current capacity of 16 amp., and with a resistance of 7 ohms, if the motor were to run at full load all the time. If, however, the motor were to carry only half load, then it would draw about 8 amp. current, and to use up the 105 volts, would require 105 ÷ 8 = about 13 ohms.

You would, therefore, have to supply a resistance, which could, of course, be varied—the part to be used for full load having capacity for 16 amp. and resistance of 7 ohms, and an additional section having a

capacity of 8 amp. and a resistance of 6 ohms. This would take about a No. 8 iron wire for the full load resistance, and would require about 1600 ft., and for the additional half load resistance, No. 12 wire, about 500 ft.

This would be rather a bothersome thing to handle, and also you would be wasting the energy required to force current through the resistance, which would be in proportion to that utilized in the motor as 105 to 115; or to get 2 hp. delivered by your motor, you would waste 1.83 hp.

The best thing to do is to get a 220-volt motor and sell the 115-volt. A. L. R.

Locomotive Boiler Construction

WHERE is the weakest place in a locomotive style boiler and in what way do you figure the safe working pressure? Where can I get a catalog with drawing showing bracing of one of these boilers? What is the proper way to change from noncondensing to condensing in Corliss engines, single or double eccentric? S. D. S.

A. The weakest part of a locomotive type boiler is the crown sheet. As a general rule, this is the point where rupture occurs in an explosion, and is due partly to the fact that it is subject to the most intense heat from the fire, it is nearly flat in some boilers, and has to be stayed by some form of staybolts or braces, which are inaccessible for inspection, its shape is such that scale is easily collected, and is very difficult to remove. Also, there is very little water above it to protect it from the fire, and it is easily overheated.

In figuring the safe working pressure of the boiler the several parts should be figured separately, and the one which shows the least maximum allowable pressure is the one taken as the safe pressure. The maximum allowable pressure as figured from the barrel is:

(A) $P = \frac{T \times t \times E}{R \times F}$ in which P = maximum allowable pressure; T = tensile strength of the plate; t = the minimum thickness of plate in inches; E = efficiency of the longitudinal joint which is determined by analyzing the joint as described in the book of rules; R = the radius of the shell in inches; F = the factor of safety which for this type of boiler is 6. The lowest per cent of efficiency as found in this manner is used in the above rule.

To find the maximum allowable pressure on the staybolted surface (B) $\frac{S \times a}{A} = P$, in which S = the allowable stress in pounds per square inch, per cross-sectional area, which for sizes up to 1¼ in. is 6500 lb per sq. in. and over 1¼ in., 7000 lb. per sq. in.; A = area of surface between 4 bolts which is considered as the area supported by one bolt; a = net area of staybolt at root of thread less the area of the telltale hole. The area at the bottom of the thread is found by the rule $D - (p \times 1.732) = d$, in which D = the diameter of the bolt over the thread; p = the pitch of the thread; d = the net diameter at the root of thread; 1.732 = a constant. The area of (d) less the area of the telltale hole is the value (a) in the above rule.

In figuring the stress on the stayrods the area supported is taken as the area of the segment of a circle, the arc of which is about 3 in. from the shell, and the chord 2½ in. above the top of the tubes. This area is found by the rule, $\frac{4H^2}{3}\sqrt{\frac{2R}{H}} - 0.608$ equals the area of the segment to be stayed, in which H is the height of the segment, and R the radius of the boiler less 3 in.

The maximum allowable pressure on the braces is, (C). Total area of rods supporting the head times the allowable stress in pounds per square inch of cross-sectional area divided by the area of the segment gives the maximum allowable pressure on the braces. The maximum allowable stress on the braces per square inch of cross-sectional area runs from 6500 to 9000 lb. per square inch, depending on the material and kind of brace.

The lowest allowable pressure found by the rules (A), (B) or (C) should be taken as the maximum allowable working pressure. Gussett stays are figured in the same manner as longitudinal or crowfoot stays. In figuring the safe working pressure it should be ascertained as far as possible that all the staybolts and braces carry their share of load, and that none of them are broken.

2. I do not know of any catalog that will give you any definite information concerning the bracing of these boilers. The book "Steam Boilers" by Peabody and Miller, which you can likely find at the Public Library gives detailed information with numerous drawings on this type of boiler, and there are several other books that may be found there.

3. This I think refers to the valve setting. An engine will run either noncondensing or condensing with the same valve setting. As a rule, however, it is customary to increase the compression when changing to run condensing. If the engine has a single eccentric, the exhaust valve rods would be adjusted to increase the compression. In the double eccentric engine both the exhaust rods, and the angular advance of the exhaust eccentric might be changed. In case the engine was compound, it might be necessary to change the cutoff in the low-pressure cylinder to divide the load equally, and probably the compression in the high-pressure cylinder would not be changed. There is no absolutely correct way to change from noncondensing to condensing but each case would depend on the existing conditions. J. C. Hawkins.

Calcium Chloride for Brine Tank

IN the plant where I am employed, our tank contains 455 gal. of salt brine, by weight about 4350 lb. We intend to change from salt brine to chloride of calcium brine. Kindly explain how much calcium I need to charge our tank, and how to charge it. J. B.

A. If you have 455 gal. of salt, weighing 4350 lb., it weighs 9.56 lb. per gallon, or is about 18 per cent solution.

This would have a freezing point of 8 deg. F., and to get the same freezing point with a calcium chloride, would call for about 17 per cent solution, which needs 1.5 lb. of calcium chloride per gallon. For 455 gal., this would take 683 lb., or say 700 lb. for good measure.

The method of making the brine is the same whether salt or calcium chloride is used. A box or barrel with a false bottom 3 in. above the real bottom, and perforated with ¼-in. holes, is used; the calcium chloride is spread on this false bottom, and a stream of water fed in below and running out at the top. Allowing the water to run through slowly will give a saturated solution which can be reduced to the desired percentage in the brine tank. A. L. R.

General Engineering Questions

HOW many amperes are there in a horsepower d. c. current? I figure 3.39 amp.

2. In a triple butt strap joint, why is the second row of rivets in double shear used for figuring?

3. On cards from a high speed engine which has the more compression, card from a no load or card from a full load?

4. With Corliss valves, at what part of the stroke of an engine are the valves balanced?

5. Why do they allow more pressure on an internal fired boiler than on an external fired boiler?

6. When you figure a locomotive boiler what parts do you have to be careful to look after in figuring?

7. Where does the water enter in a locomotive type of boiler?

8. Where is the combustion chamber in a locomotive type boiler?

9. If one of the governor reach rods should get broken so that you could not get the measurement, how could you get the correct length for a new one?

W. B.

A. The number of amperes in one horsepower depends on the voltage. One horsepower equals 746 watts. If the voltage is 110 the amperes will be $\frac{746}{110}$ $=6.781$ amp., at 220 volts it would be $\frac{746}{220}=3.39$ amp., 500 volts is $\frac{746}{500}=1.49$ amp., etc.

2. In the triple riveted butt joint with double cover plates the pitch of the second row is used in figuring the efficiency of the joint because the rivets in this row are in double shear without anything to back them up, while the rivets in the first row are strengthened by the row of rivets back of it through the cover plate, and the probable failure of this row would be in case all the rivets sheared. As you will notice in the book of boiler rules, the joint may fail (1) by tearing the plate between the holes in the second row and crushing the butt strap in front of one rivet in the outer row; (2) by tearing the plate between the holes in the second row and shearing one rivet in the outer row. There are other ways in which the joint might fail, but these are the principal ones in which the pitch of the rivets in the second row is considered.

3. In the usual type of single-valve high-speed engine the diagram taken with a light load will show higher compression than with full load. In some of the high-speed 2 and 4-valve engines this is not always the case as some of them give a constant compression at all loads, the only event that is changed is the point of cutoff.

4. This I assume to mean: At what part of the stroke is the pressure on the under side of the valve equal to the pressure on top of the valve? In steam valves this occurs when the valve is open for an admission, at which time the pressure is practically equal on both sides of the valve, neglecting its weight. If the compression rises above the pressure in the steam chest, however, the valve may be exactly balanced. On the exhaust valves, if the cutoff is early enough to bring the expansion line down to the atmospheric line or below, the valves will be balanced. This will occur near the end of the stroke, if at all.

5. The working pressure on all boilers is figured in the same manner, except that a higher factor of safety is required on boilers externally fired in which a lap riveted seam is exposed directly to the products of combustion. This includes the horizontal tubular boiler on account of its girth seam, but not the internal fired type in which there is usually no such seam exposed. The Ohio boiler rules use the same factor of safety unless the boiler is over 36 in. in diameter, then a lower factor is allowed, which gives a higher working pressure with the same thickness of plate.

6. In figuring the working pressure of a locomotive type boiler, I would be very careful to see that the crown sheet stays were in good condition, and not wasted away, also that the staybolts were in good condition, and none of them broken. These bolts are subjected to a very severe strain, and some of them are inaccessible for close inspection. Also examine closely the condition of the fire plates of the water leg at the mud ring. This part is exposed to the action of the acids in the ashes and is liable to become badly corroded.

7. The locomotive type of boiler is frequently fed in the water leg through the blowoff connection, which is usually located at the rear of the furnace. This is a poor location for the feed for the reason that it causes severe strains in the furnace sheets, sometimes cracking them, as well as frequently developing trouble in the staybolts in the vicinity of the feed discharge. This type of boiler can be fed at practically any point in the barrel, or front head below the water line; or if the boiler is of large size, and equipped with a manhole in the top of the shell, a steam space feed may be used to advantage.

8. The combustion chamber in the locomotive type boiler is the space in the fire box above the fuel bed. This is very small, hence the combustion is incomplete, and much smoke is the result, except at very light loads.

9. To get the length of the missing rod, block the governor up to about the usual running height, unhook the reach rod, and put in the starting bar. Hook up the valve on which the governor rod is in place. Turn the wristplate until the latch strikes the knockoff cam, and releases. Then notice how far the center line on the wristplate has moved from the line on the hub showing the limit of travel. Set a pair of compasses to this distance. Next hook up the other valve on which the rod is missing, and draw it up until the marks on that side are the same distance apart as measured by the compasses. Hold the wristplate in that position, and move the knockoff cam around until it releases the latch. Then measure the distance from the end of the reach rod head on the knockoff cam, to the end of the head on the governor lever, and add about 1¾ in. on each end for thread. The length of the thread, its diameter and pitch may be found from the other rod, also the diameter of the body of the rod. This will give an approximate measurement. After putting in the new rod the cutoff can be equalized by the indicator. J. C. Hawkins.

MANKATO, MINN. CITY COUNCIL, failing to receive a satisfactory proposition from the Consumers' Power Co., for renewing the street lighting contract, which expires Dec. 1, has voted unanimously to install a municipal lighting plant, and will at once secure competent engineers to prepare the necessary plans and specifications. It is likely that a plant large enough to do commercial lighting will be installed.

Problems For Discussion By Readers

What Would You Do If You Had These Conditions To Meet?

Heat Value of Fuels

WHICH has more heat units, Hocking Valley screenings or mixed hard and soft wood sawdust and shavings fired under ordinary conditions and on coal grate bars, ⅜-in. openings, horizontal tubular boilers? I am in a position to buy 2000 lb. of these shavings for $1.00, coal is costing us, put in coal bin, $2.60. This is a woodworking plant and we do not have enough shavings and sawdust to run the plant.

E. K.

Length Required to Shorten Belt

HOW much should be cut from the actual length of a 1-ply, 2-ply, and 3-ply leather belt to make it tight enough to carry the load allowable on such belts? Conditions are a double leather belt 21½ in. wide, 81 ft. 2½ in. long, running from a 12-ft. flywheel to a 68-in. pulley on main line shaft. The distance around the pulleys is 82 ft. 3½ in., showing a stretch of 13 in. on the belt. That was too slack to carry the load.

The belt will be made 3-ply before being put on again. How much shorter would you advise making it? It is to be spliced as an endless belt.

The belt has been in service about 14 yr., running 6 months a year, 132 hr. a week. It averages about 32 oz. per square foot, 2-ply. W. L. B.

Valve Rattle

WE have in operation at a coal mine here a 16 by 32-in. direct connected hoisting engine. The valves are balanced (slide) by means of a heavy pressure plate held to the back of the valve by 4 coil springs. When the engine is drifting, the pressure plate and valve rattle in an annoying and disagreeable manner, due to the partial vacuum created by the moving pistons. I have tried to overcome this by using heavier springs on the back of the pressure plate, but to no avail.

I called the builders' attention to the matter, asking them to furnish me a steam chest check for each engine. They answered by sending me 2 oldfashioned 1¼-in. line checks commonly used for and on feed lines to boilers. Kindly give me some advice in the matter. Are they suitable for the purpose for which I need them? If so, are they large enough? Our boilers carry 100 lb. gage pressure. The engine lifts the load 230 ft. in 10 sec. F. W. O.

Reading Wattmeters

IN the issue of July 1, J. I. asks for information about reading wattmeters, and gives 4 sets of dials to be read.

Reading a wattmeter seems to be one of the hardest easy things that falls to the lot of an engineer. The chief cause of error is due to defective setting of the hands.

There are 2 rules which, if rigidly followed, will make reading meters easy. The first is that the heading over a dial represents the quantity when the dial finger has made a complete revolution; and each of the 10 spaces around the dial signifies 0.1 of the quantity over the dial. For instance, if a dial labeled 10,000,000 has the hand pointing at 2, it should be read 0.2 of 10,000,000 or 2,000,000 and not 20,000,000. The second rule is, that when a finger points at or quite closely to a figure on the dial, always look at the next lower dial to determine whether or not the finger has reached the dividing point.

In reading time on a watch, a person unconsciously looks at the minute hand, to determine whether it is past or not past the even hour. Suppose we have the hour hand pointing directly at 2 o'clock and the minute hand at 5 min. past. Without the minute hand, we could not tell whether it was 2 o'clock yet, as the movement of the hour hand in one hour is too small, and the hand might not be set correctly anyway.

The best way to set the hands is to wait until the hand on the largest dial points directly at a division point and then set all the other hands to zero.

John Bailey.

Length of Indicator Cards

IN reply to the question of W. I. in Aug. 15 issue, page 807, the indicator cards vary in length, even with the same cord and indicator attached. Theoretically, there should be no difference in the length of diagrams, all things being the same. Yet, stretch of the cord, inertia of the drum, and loose fittings in reducing motion, or even method of hooking up, have some bearing on the card length. If the cord is unusually long—say, about 3 or 4 ft. or more—the vibration set up may have a tendency to vary the length in the different cards, or even for the different ends of the same cards.

The increase or decrease of load should have no bearing whatever on the variation of length of the card, especially not to the extent of ⅛ in. in 4. The stroke of the engine remains practically constant, and the reducing motion will likewise give a constant length for the card. F. W. B.

FOR CLEANING CONCRETE surfaces of stains due to weather and other causes, a wash of dilute hydrochloric acid, 1 part commercial 30 per cent acid to 5 parts water, has been effective in the Panama Canal zone. The surface of the concrete is brushed over with solution and afterwards rinsed with clear water which removes all discoloration. Watch is now being kept to see whether there are any after effects or return of the stains.

NO LIFE IS WASTED in the great worker's hand. The gem too poor to polish in itself, we grind to brighten others.

—Philip James Bailey.

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EXPOSING ONESELF TO PROMOTION

"What's the use? You don't get no credit for it."

How often one hears expressions similar to this, from men employed in almost every trade and profession, but one finds it more among those employed in factories than elsewhere, and it has found its way even to the field of power, which is to be regretted.

In many large establishments, where the employes number well on into the thousands, or even hundreds, where there are gathered together men of many temperaments, it is but natural to expect to find men of many ideas as to what constitutes a proper attitude toward the firm and the several foremen and others who have direct charge of the production.

The idea is all too prevalent that the firm is in duty bound to give employment to men, irrespective of their skill, or ability or of their interest or disinterest in the welfare of the firm.

For many years, and especially during the last decade, there has been a large increase in the number of employers who are inaugurating the profit sharing plan or a pension fund for faithful and continued service, or benevolent associations for the use of employes.

This is an age of intricate tools and machines, and with the passage of time, more and more skill is required to operate these machines and tools, and employers saw that in order to keep the machines in the best order possible for the rapid and economical production of finished goods, it was necessary to secure and keep competent and faithful help.

Where men were changing from shop to shop at frequent intervals, considerable time was lost in becoming familiar with the work and the tools for producing it, frequently accompanied by expensive accidents and delays, which increased cost of upkeep, and consequently, the cost of production. This increase reverted to the payroll to a greater extent than was generally believed.

To circumvent these losses, many firms inaugurated means of increasing the interest of the employe in the firm in one form or another. Many firms declare a certain amount of dividend annually among the stockholders, and divide a certain surplus among the employes on a sliding scale depending on the length of service and pay received. Other firms, especially railroads and those in the iron industries, arrange to let their employe secure stock in the concern at a rate below that quoted on the open market, and on terms in keeping with his living expenses. These, with the pension and benevolent funds, can but have one effect, and that is give the employes a far greater interest in the welfare of the firm than could be accomplished without such means.

Still, with these many benefits being placed within easy reach of employes, there are still many who take the view that they are entitled to all these bene-

fits without giving anything in return, and who even go so far as to say that favoritism is being displayed to their disadvantage.

Not all the new ideas are brought out by those who, through study and work, have risen to positions of trust. Frequently, a man in a subordinate position suggests ideas that are of great benefit to the employer, and often such a man feels that his reward should be substantial at the time, and finding that he has not been remembered in this manner, remarks:

"Oh, what's the use? You don't get no credit for it."

Leaving out for the moment all these benefits for the employes, one who works for a living as a mechanic (or in any other position for that matter) ought to have enough personal pride in his work to arouse him to do his very best. A fitting financial or other reward ought to be the last consideration at the time the work is performed.

There are many employed in the generation and transmission of power, who feel that they are overlooked. The fireman grows careless and consequently wasteful; the engineers waste oil, etc., on the plea that "the company has got lots of money." There are many places where these little leaks are permitted to appear and grow, on the plea that one does not receive credit for exceptional efforts along the line of economy.

Today, more than ever, is the day of individuality. Today, more than ever before, there is a dearth of good intelligent men to fill positions higher up with certain satisfaction. Today, more than ever, there ought to be exceptional efforts displayed by all, and especially the rising young men, to qualify for advancement.

This does not necessarily mean that one should devote several years to technical schooling, although such training must be given due credit. But there are advantages and opportunities presented in every power house for study and research which are lacking either wholly or partially, in even the best technical schools.

The first step in preparation for these better opportunities which would otherwise pass by, is to cultivate individuality. Strive to stand out above the others on such a firm foundation that you will not be overlooked when a careful eye is searching for a reliable person to fill a better position.

To do this, cultivate the habit of doing your work, faithfully, and cheerfully, throwing your whole soul into it. Think less of possible credit and more of a satisfied mind, and the remainder is comparatively easy, for you then become an individual who, through results, stands out where he can be seen when wanted.

FORESTALLING THE PEAKS AND VALLEYS

It is well recognized that in order to get the best economy from a plant, there must be a uniform load which is a reasonably large per cent of the rated load of the machinery in use, and conditions must be held constant with but little fluctuations, and those placed well apart so that the machinery has time to adjust itself before the effect of another change is felt. In practice it is certain that no such conditions can be secured, except in specially favored plants, such as pumping stations and blowing engines. In the central station, which has to furnish current for lighting and street railways, the peaks and valleys must be taken as they come, but by watching the weather conditions, the lighting station superintendent can often forestall changes by several minutes. By studying the daily load record, and allowing for special loads of which he is forewarned, the street railway men can also get a pretty definite idea of how the load is likely to come on.

In industrial plants, however, the load is liable to vary very much at the will of the foremen of the different departments, or sometimes even by the whim or the needs of operators of machines which demand large amounts of power or large quantities of steam. When the peak demand is sudden, the boiler may be caught with low water and with fires well burned out, and it may be sometime before the fireman can get his machinery back in proper condition to meet the demand. The valley, or cutting off of power, may come just at the time when the fires are high, water level is up, and the result is a popping safety valve, with consequent waste of energy, and this may go on for some little time before the fires have cooled and the water level been lowered to meet the new conditions. If daily load record is kept, it may be possible by study of the curves from day to day, to get an idea of about when the changes are likely to come, but a simpler and more effective method is noted in a contemporary, Factory, which tells of the installation of a system of electric bells, in the fireroom, with push buttons at each station, where large amounts of power are likely to be called for suddenly. The operator of a machine then pushes his button 5 or 10 min. before he is ready to cut in or cut out his load which gives the fireman a chance to regulate the conditions of the boiler accordingly. This avoids the necessity of opening firing doors to cut down the popping of the safety valve and also avoids the need for forcing the fires in order to catch up with a falling steam pressure. A still better method would be the studying of the plant operations, so that they might be carried on through the day to give a practically constant load. It would be just as easy to do this as to run the operations haphazard and have the load fluctuating up and down. All that is necessary to bring about such a condition is for the factory superintendent to realize the waste that is caused by having the load vary, and to be shown how a schedule may be worked out which will make the power demand uniform and the saving in material and repair expense which may be secured by having such a schedule.

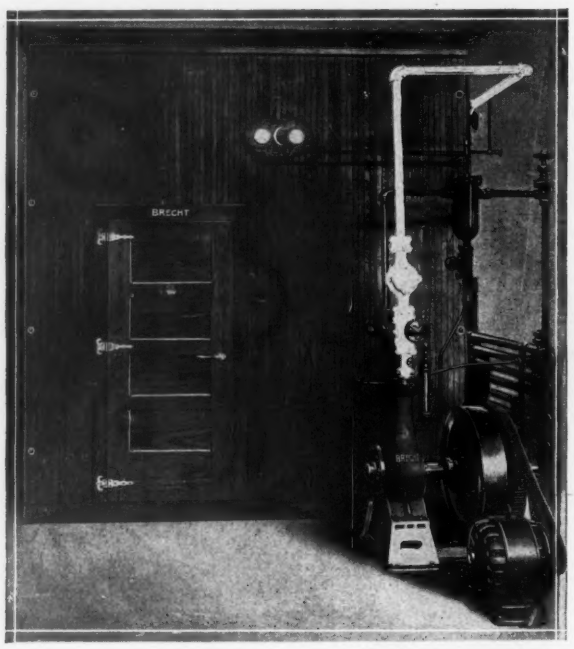
Power Apparatus in Shop and Market

New Ideas In Making, Buying and Selling

SMALL MOTOR-DRIVEN REFRIGERATING PLANT

SMALL motor-driven refrigerating plants, of which a typical example is shown in the illustration, are being used more extensively every day. Like the vacuum cleaner and the artificial ventilating system, it provides a modern and efficient means for producing results that are necessary for human health and comfort.

The use of ice to produce cold is passing away because it is uneconomical, unsatisfactory, and unsanitary. Under the best of circumstances, much ice must go to waste because of the inherent difficulties of keeping it properly. Where there is ice there must be dampness,



SMALL REFRIGERATING OUTFIT

and damp wood, sawdust, and drains are always germ laden. The temperature produced by ice cannot be easily regulated, and the maximum degree of cold that can possibly be produced is not sufficient for many purposes. Moreover, the process of filling the ice chest always creates a mess, objectionable alike to the housewife and the business man, while the ever present dampness greatly lessens the life of the refrigerator.

Mechanical refrigeration eliminates all these disadvantages. It supplies dry cold of any desired degree; the temperature can be readily varied to suit different purposes; and experience goes to prove that, under average conditions, mechanical refrigeration is cheaper than ice.

The electric motor permits the use of mechanical refrigeration in small units, which need little attention and that only of the kind the average janitor is competent to give.

These outfits are being used extensively by butchers, grocers, dairymen, hotels, restaurants, public institutions, large residences, etc., for preserving food and for making ice in small quantities. Ice cream plants find them far superior to old salt and ice mixture for freezing and hardening the cream. Large industrial plants use them for cooling drinking water, which is pumped to fountains in all parts of the works. The florist finds a special application for preserving flowers and preventing buds from opening until wanted for sale. Modern apartment houses supply each tenant with a mechanically cooled refrigerator, thus eliminating the visits of the ice man.

The cost of operation varies, of course, with conditions, the principal items of the operating expense being for power, water, oil and ammonia. The last two are small, as little oil is needed and one change of ammonia should last a year or two.

The cost of power depends on the size of the plant, 2 hp. per ton of refrigerating capacity being the size of motor usually recommended. The illustration shows a 10-hp. Westinghouse motor driving a Brecht refrigerating machine.

BOILER PLANT EFFICIENCY

EVERY owner of a boiler plant, however large or small it may be, is interested in its efficiency and economy. Man's greatest agent to accomplish work is steam, and every dollar saved is as important as a dollar earned. The greatest factor in cost of producing steam is coal, but of every pound of coal burned to make steam for power only ¼ of the energy is utilized, often less, on account of imperfect combustion, loss delivery from the boiler to the engine, and loss in the engine. These unavoidable losses must be made up as far as possible by savings in other directions that can be obtained by careful supervision of many details.

One important cause of loss is the presence of scale in boilers precipitated from the feed water. This waste is known to every engineer, but in some cases it is regarded as part of the general loss or cost of steam production and but little attention is paid to it, until the accumulation assumes such proportions as seriously to handicap the production of power, and then the boilers are put out of commission until the scale can be removed by mechanical means at a considerable cost of labor and time.

In most cases, however, efforts are made to prevent formation of scale. Practice has been to try to treat the boiler feed water, either by a softening process for the elimination of acids and alkalis or by chemical compounds designed to act on the water after an analysis of the same, or by a mechanical cleaner.

After much research along all these lines of water treatment, a German chemist turned his attention to the matter of a metal treatment, and finally produced a

chemical preparation for mechanical action, which German engineers, have adopted for general use, and this metal treatment has spread throughout all European countries, and is now in use in the United States and Canada under the name of Perolin.

The chemicals in solution have a strong affinity for hot metal, and when the required amount for a 12-hr. run is fed direct into each boiler at the commencement of the days run, or both morning and evening on a 24-hr. run, the preparation works between the metal and the scale and by expansion breaks the adhesion, loosing the scale ready to be removed at the first washout, or blown out in the blowoff pipe, if of a porous nature.

Protection of the metal of the boiler from corrosion or pitting and prevention of scale formations is accomplished by covering all exposed metal surfaces with a preservative film, white in appearance when the boiler is cold, and a good conductor of heat. In a new boiler the film preserves the tubes and shell against repairs, and if a shell or tube is pitted or grooved, the film will fill up and cover over the pitting and prevent further corrosion or incrustation.

THE SARCO WATER TEMPERATURE REGULATOR

THIS regulator uses as its motive power, expansion of a sensitive liquid contained within a chamber, into which a flexible corrugated tube is inserted. It is, therefore, compact, simple, and wholly self-contained, requiring no exterior operative means such as compressed air. The apparatus has an adjustable regulating device, by which any desired temperature within a given limit can be maintained constantly. Figure 1, a sectional view, shows the internal construction of the apparatus, the action being as follows:

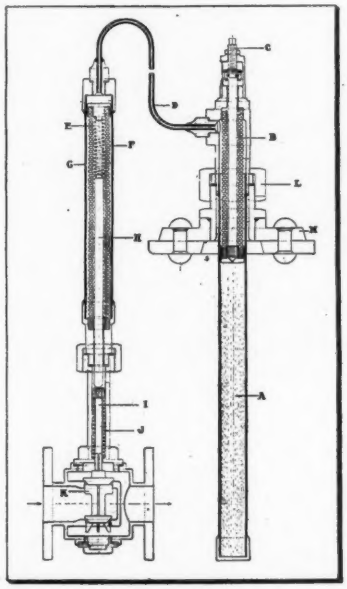


FIG. 1. SECTIONAL VIEW OF SARCO TEMPERATURE REGULATOR

The thermostatic element A is inserted in the boiler or tank, and is a tubular receptacle containing a heavy hydrocarbon oil, with a piece of corrugated tubing inserted in it. The length of this tubing is extended or reduced by turning the regulator head C, which regulates the temperature. From this thermostatic element, a piece of fine copper tubing D passes to the controller G, which also contains a piece of corrugated tubing capable of compression, when an increase from temperature causes the liquid in A to expand. The element A, the tube D and the controlling mechanism G form a single closed chamber. When temperature increases in A, the pressure increases and is transmitted to (F), causing a pressure in the tube (G), which forces down the tension spring and tends to close the valve against the tension of valve springs at E and J, which operate in the opposing direction, tending to keep the valve open. The valve K is, of course, placed in the steam line, supplying steam direct to the boiler or tank. It will be seen that the apparatus is simple, capable of quite delicate adjustment, easy to install and not at all likely to get out of order. It is manufactured by the Sarco Engineering Co., 116 Broad St., New York. Fig. 2 gives a view of the complete apparatus assembled, the thermostatic element being on the left, with the controlling screw at the top, and the controller element at the right, above the valve.

A NEW RECORDER PEN ARM

CHANGING of charts on a recording instrument which has a rigid pen arm is attended with some annoyance, as lifting the arm from the chart holder and retaining it with one hand while the chart is changed with the other requires practice and dexterity to avoid spilling the ink or soiling the chart.

In the new form arm used on the Columbia recording thermometers and tachometers made by Schaeffer and Budenberg Mfg. Co. of Brooklyn, N. Y., the pen carrier proper is made separate from the driving arm and has an adjusting screw which, by a pin and slot, joins the 2 parts and regulates their relative position. When changing the chart, the outer part or "arm" is drawn forward off the pin and allowed to drop to the right at an angle which carries it away from in front of the chart. There the arm rests while the chart is changed, both hands being free for this purpose.

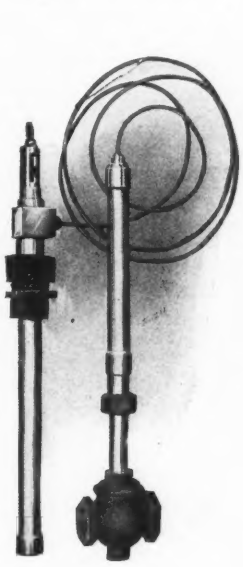


FIG. 2. ASSEMBLED VIEW OF SARCO TEMPERATURE REGULATOR

THE ADJUSTABLE PEN ARM OF COLUMBIA RECORDING THERMOMETER

The arm is then slipped back over the pin in the adjusting screw and is ready to be controlled by the "pedestal" or driving arm. A slight turning of the screw to right or left adjusts the pen arm to register correctly whenever necessary.

IMPROVED FLOW METER

THE General Electric Co., Schenectady, N. Y., has recently produced an improved flow meter for measuring steam in any of the following 4 different ways: 1st, as a recording instrument; 2nd, with both indicating and recording chart; 3rd, with recording chart and integrating dials; 4th, with indicating scale, recording chart and integrating dials.

Being a hollow casting, the body of the meter suitably becomes a combined mercury reservoir and one leg of a U tube, the outer leg being formed by a pipe which opens into the reservoir. Resting on the top of and rising and falling with the mercury, is a float which is geared by a rack and pinion to a horizontal shaft carrying a permanent U shaped magnet. The poles of this magnet face a copper cap which closes an opening into the meter body. No mechanical connection exists between the mechanism in the mercury reservoir and that on the outside, which operates the recording and indicating devices, thereby dispensing with the usual necessary packing to prevent leakage. Facing the reservoir magnet but on the outside of the copper cap is a smaller magnet mounted on a shaft which is parallel to the inner shaft. This second magnet is affected by any movement of the one inside and its rotation is transmitted to the indicating needle and recording pen.

The meter is easily attached to any steam line by a nozzle plug and connecting piping. The nozzle plug consists of a tube with 2 separate conduits in it, each having a set of openings on diametrically opposite sides of the tubes. The so-called "leading" set facing the flow, are acted on by a pressure equal to the velocity head plus the static pressure of the fluid. Suction

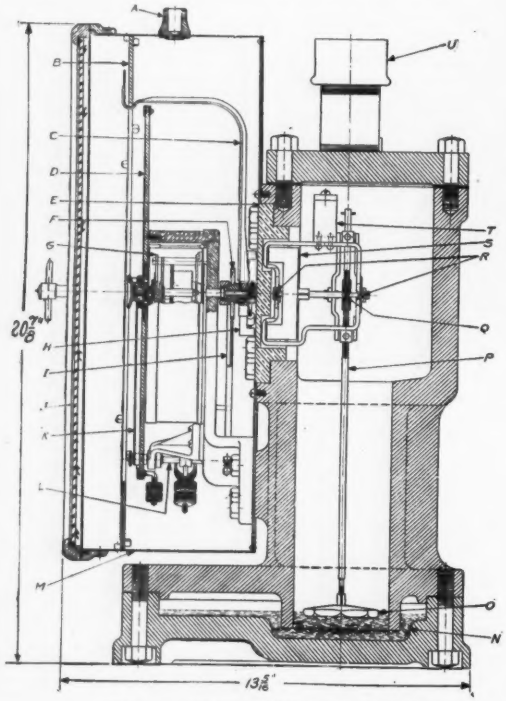


FIG. 1. CROSS-SECTION OF METER

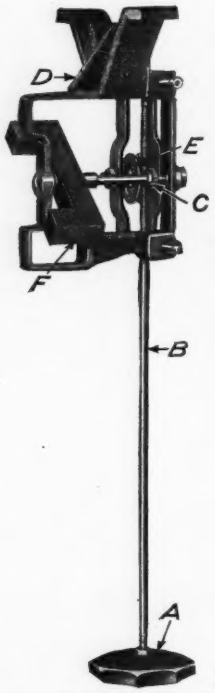


FIG. 2. INTERNAL MECHANISM BODY OF FLOW METER

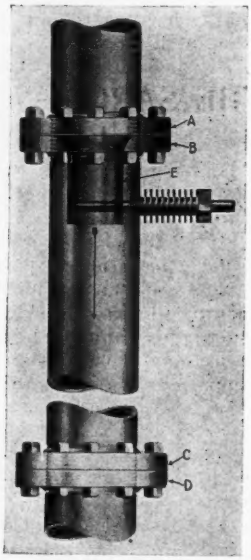


FIG. 3. PIPE REDUCER AND NOZZLE PLUG INSTALLED IN A PIPE

FIG. 4. INDICATING, RECORDING AND INTEGRATING FLOW METER

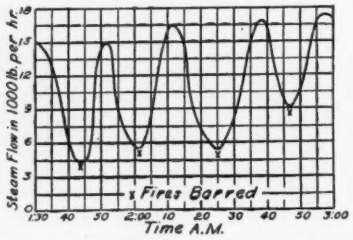


FIG. 5. CURVE OF METER RECORDING FALL IN PRESSURE DUE TO DEFECTIVE FIRE AND TIME REQUIRED TO REMEDY IT

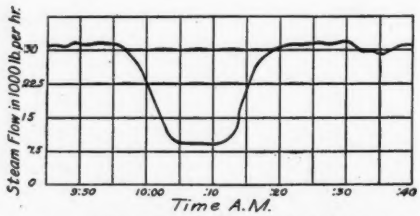


FIG. 6. CURVE SHOWING PERIODIC FALL IN STEAM DELIVERY OWING TO WORN CAMS ON AUTOMATIC STOKER

is produced in the "trailing" set. The unbalanced pressure of the 2 sets of openings acts on the column of mercury in the U tube, thereby causing a movement of the float which actuates in turn the rack and pinion, and shaft with attached U magnet, all inside of the mercury reservoir. The movement of the magnet is transmitted to the outer magnet through the copper cap by means of the magnetic flux. This latter magnet in turn moves its shaft and thereby the indicating and recording mechanism.

A recording pen on the usual circular chart, rotated by clockwork, gives a continuous record of the steam flow. Connected to the outer shaft and moving with the recording pen is a cam which determines the angular position of a planimeter wheel. This wheel driven by the chart paper forms the integrating device of the meter, and the planimeter dial readings multiplied by a constant furnished with the meter, gives the flow in the desired unit.

DAMPPROOFING VS. WATERPROOFING CONCRETE

DAMPPROOFING a wall so that it will shed water is quite different from waterproofing a wall against water pressure. Dampproofing means protection against a damp atmosphere and moisture in various forms not under pressure. Waterproofing, on the other hand, in its modern sense, means insulation against water pressure and against electrolysis. The former may be obtained by applying a coating of preservative paint having the proper qualifications. A film of paint, however, cannot be depended upon to resist pressure or be a dependable insulation against electric currents.

That dampproofing and waterproofing must each be treated as distinct problems in themselves is claimed by the Hydrex Felt & Engineering Co., which makes a special preservative paint used for dampproofing but never for waterproofing. For the latter is always recommended the "Membrane Method," that is, the use of several layers of regular Hydrex waterproofing felt cemented together with hot compound. By this process, the concrete may contract, expand, settle or crack, without injury to the waterproof stratum.

A good preservative paint for use on concrete must be made from a pure mineral base using a solvent which is volatile and penetrating. It then carries into the pores and thoroughly bonds and holds to the concrete surface which should be hard before the paint is put on. When applied to the backs of retaining walls, abutments, etc., such a paint prevents the concrete from absorbing water and becoming disfigured by the efflorescence so frequently seen on the faces of such structures. For walls of this type there is practically no pressure to force the water into the concrete. The paint merely allows the wall to shed the water.

For foundations of modern reinforced concrete buildings, both the presence of hydraulic pressure and electric currents call for a more lasting protection than a coat of paint or even hot bitumen. A membrane protection entirely independent of the concrete surface is far superior both as a nonconductor and as a water pressure resister.

NEW ROTARY POWER PUMP

INTERMESHING gear style cams acting as combined water impellers and power transmitters are the distinctive features of a new type of rotary power pump recently developed by the Goulds Mfg. Co.

The pumps are mounted on cast-iron bed plates, fitted with outboard bearings and equipped with tight and loose pulleys for belt drive.

Two sizes are built: No. 1 has a capacity of 25 to

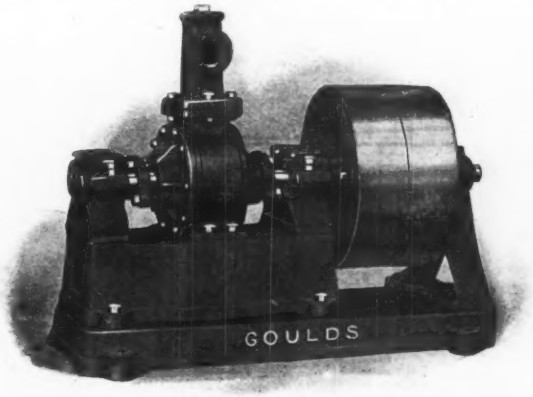


FIG. 1. GOULDS NEW ROTARY POWER PUMP

50 gal. per minute at 225 to 450 r.p.m. It has a 3-in. suction on lower side of pump case and 2 1½-in. discharge openings, one tapped for pipe and the other threaded for hose couplings. No. 2 size has a capacity of 50 to 100 gal. per min. at 225 to 450 r.p.m. It is

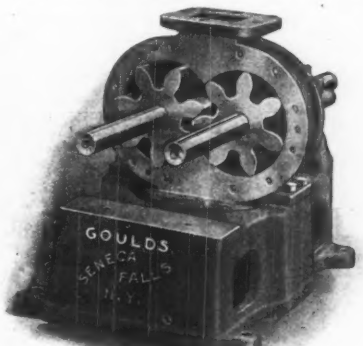


FIG. 2. CROSS SECTION OF GOULDS ROTARY PUMPS

provided with a 4-in. suction, also, on lower side of pump case, and 2 2-in. discharge openings fitted as in No. 1 pump, with a third discharge fitted with an interchangeable blank flange. The suction connections are reached through hand-holes in the bed plates.

FOR THOSE WHO have to deal with gasoline engines in cold weather the question of priming at the starting is sometimes a serious one. A correspondent in Gas Power gives the following as a satisfactory mixture of gasoline and ether to use for priming. Four parts gasoline to 2 of ether; the engine is primed with this mixture, then cranked over once and it is said to start every time.

WATER-JACKETED SOOT BLOWER

DIAMOND Model G water-jacketed soot blower has been designed especially for Stirling, B. & W., and all other types of water-tube boilers. Each unit is absolutely protected from burning by the water jacket which is constant and continuous. It is operated from the floor, the pulling of a chain directs a jet of steam with cyclonic force around each tube scouring soot from every nook and corner and driving it out up the stack.

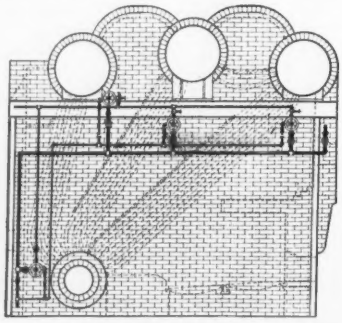


FIG. 1. DIAMOND MODEL G SOOT BLOWER INSTALLED IN STIRLING BOILER SETTING

Operating entirely from the outside no air is admitted. The blower is easily installed, a 3½-in. hole through the wall being all that is necessary and it can be done in odd minutes without interfering with the operation of the boiler in the least.

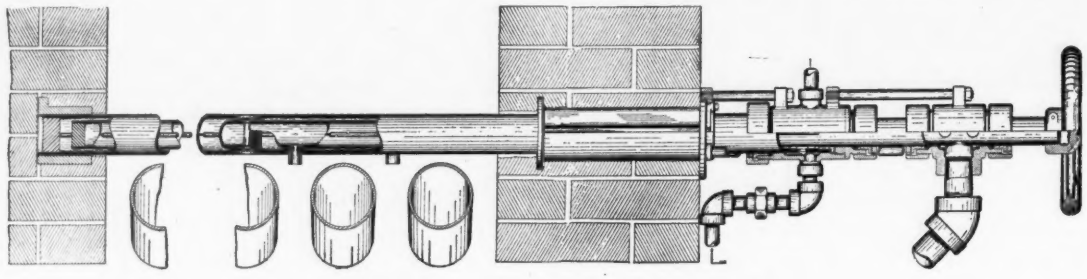


FIG. 2. DETAILS OF WATER-JACKETED SOOT BLOWER

Perhaps one of the most remarkable features of the blower is the low operating cost—¼ of a cent a day for water, if wasted—but the water may be returned to the boiler or reclaimed in an open heater. With ordinary care the blower will last as long as the boiler itself.

The Diamond Power Specialty Co., 76 First Street, Detroit, is the manufacturer of this appliance.

ELECTRIC ARC WELDING

USE of the electric arc for producing high temperature has been known for many years, and the common practice is to connect the work to be repaired with one wire from the electric circuit and to attach the other wire to an electrode handled by the operator. The electrode is first brought into contact with the work, establishing a circuit, and then drawn away forming an arc. The operator can then move his electrode about over the work and the arc will follow, so that he can concentrate the heat on one spot or spread it over a wide area. As only 10 to 60 volts is necessary at the arc, it is evidently wasteful to secure this by introducing resistance in series with ordinary 110-volt circuits, and the C. & C. Electric Welding Outfit has been perfected to overcome this waste.

A special motor generator set with automatic controlling apparatus gives a means of efficiently changing the shop circuit voltage whether alternating or direct-current to the voltage required for welding, and at the same time provides against short-circuiting of either the shop circuits or the welding machine.

Two classes of electric arc welding are in use, one requiring a graphite electrode and the other a metallic electrode. The graphite method requires 50 to 60 volts at the arc and a current of 300 amp. or more, and is used for all kinds of welding, filling in, building up, cutting, etc. In this method the filling in or welding metal is supplied from an outside source, usually a rod of soft iron or steel or a piece of scrap metal which the operator applies so that the arc will melt and form it into a homogeneous mass with the part being repaired.

When the metallic electrode is used, the voltage at the arc is lower, according to the nature of the work and the metallic electrode is consumed, particles of the molten metal from it being deposited on the work which is under repair. This necessitates interrupting the work occasionally to renew the electrode, but it has important use in repairing cracks in large work, for the operator can work on vertical or overhead surfaces, which is difficult with the graphite electrode method.

The welding outfit mentioned, which is made by the C. & C. Electric & Mfg. Co., of Garwood, N. J., is arranged to use either method and can have an electrode arranged so that by pressing a button the operator can use graphite or metallic at his pleasure as desired. Or, different circuits may be arranged, one of which will accommodate the graphite method, and the other the metallic electrode. The switchboard is also arranged so that the full capacity of the machine can be used for either graphite or metallic welding as may be desired.

In order to provide against a short circuit when an electrode is brought in contact with the work, the switchboard is arranged with an automatic device so that when the circuit is broken a resistance is inserted in series with the electrode and stays in series until the arc is formed when this resistance is automatically cut out of circuit and the full voltage of the welding circuit supplied between the electrode and the work. The application of electric welding is wide and is becoming more and more common, and this apparatus furnishes a convenient and effective means of application for any class of work.

SOME MODERN BELT METHODS

TRANSMISSION of power through shafting under favorable conditions is more efficient than is generally supposed. Much depends upon the care exercised in hanging the shafting and in the arrangements of the pulleys, and more important still, the tension in the belts.

In Prof. Goodman's text, Mechanics Applied to Engineering, it is shown that if properly lined up a solid shaft with ordinary bearings would transmit power a distance of 6000 ft. with an efficiency of 80 per cent when all forces are purely torsional. With belts, in which bending and torsion are necessarily combined, that distance drops to 400 ft. But 400 ft. is a much greater distance than is accomplished by shafting under ordinary conditions with an efficiency of 80 per cent; 60 per cent is high, and it is not uncommon to allow a 50 per cent loss of power in the shafting of many modern machine shops.

It is not difficult to show how these losses may in a large measure be prevented. If, without belts, power can be transmitted 12.5 times farther than with belts, and with the same efficiency, it will surely pay to give belts serious consideration.

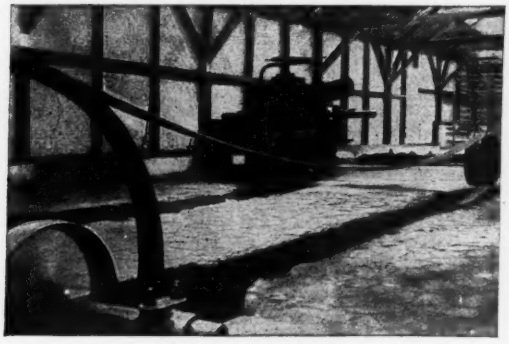


FIG. 1. BELT IN JAVA TREATED TO PREVENT CHANGE WITH WEATHER VARIATION

Many belt drives are arranged with only one hanger to give rigidity to the driven pulley. The tensions in a tight belt are sufficient to deflect the shafting considerably, and the slightest deflection affects the transmission efficiency, as Prof. Goodman forcibly indicates. In operation the shafting maintains that deflected form, and the friction, both internal and in the bearings, increases with the amount of deflection. It is necessary then to reduce the belt tensions as much as possible, and the only way to do this effectively is to treat the belt properly.

Assuming that belt tensions are necessary, but knowing that in operation one side can run slack or easy, suppose a tension of 200 lb. is needed by a belt according to the formulas used by some engineers. Suppose that tension is nicely adjusted some day when the thermometer registers 70 deg. F., and the humidity is low; the belt drives satisfactorily on that day; that is, it does not slip. Next day the temperature rises and the humidity increases. Both are factors that lengthen belts and destroy the fine adjustment made on the previous day. The belt treatment is imperfect. The belt slips. Besides, if the weather conditions hadn't changed, the belt would have stretched slowly and a new adjustment would soon have to be made anyway.

In tropical regions some belts have been known to change length 6 in. in one day for the reasons just mentioned. Humidity is the principal cause of trouble when the belts are not waterproof. Where slight initial tension is needed the belt must, therefore, be waterproof to give the best results.

There are admittedly good waterproof belts on the market, but why throw belts away and buy new ones when any belt can be waterproofed inexpensively and at the same time the belt efficiency will be increased? The belt efficiency is increased because the bending qualities of the belt are improved, the belt is made flexible and slipping is prevented. Ordinary leather belts can be made immune to damp or stormy surroundings or to the actual slopping of water on the belts, by proper application of Cling-Surface.

A belt with riveted joints, treated in this way, is made absolutely waterproof and can be run submerged in a water pit, as has been proved in instances where for several days, floods buried such belts. The preservative treatment rendered them immune in even such severe cases. A cemented belt, excepting the

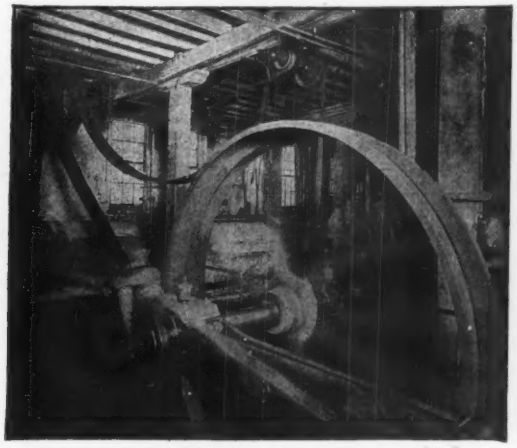


FIG. 2. BELT DRIVE IN A LAUNDRY SHOWING THE SLACK PERMISSIBLE IN A PLIABLE BELT WITH GOOD ADHESION TO PULLEYS

edges of the seam, is also waterproof, and although it might not withstand prolonged submerging, it will successfully resist dampness and steam.

Since leather belts are made up entirely of small fibers, it is the action of the fibers that must be studied. As soon as understood, they can be given intelligent protection. When anything is bent, internal friction is brought in play somewhere. This is proved by the increase in temperature of rods while bending. When a belt is bent, every fiber is forced to rub against its neighbor. It is the fibrous construction of a leather belt that makes it porous. These pores or spaces may be easily filled with any fluid substance, and unless first treated on the outside and well filled with some substance that resists moisture, moisture will easily get in and out.

Alternate wetting and drying shortens the life of any kind of leather as wearers of leather shoes or gloves well know. When Cling-Surface treatment is applied it serves more purposes than one. In occupying all the spaces in the belt it surrounds every fiber and acts as a preservative lubricant for the fibers when one rubs against the other in bending the belt. An

untreated belt wears out more quickly than a treated belt, because in bending the gradual grinding of the fiber hastens internal wear. Besides, this treatment gives a leather belt the kind of flexibility needed to insure non-slipping—a modern feature clearly shown in the illustrations.

In painted cotton belts which have been allowed to dry and crack, fissures appear and gape open and chafe together as the belt goes around the pulleys. It is an easy matter for water to get in through the openings made, but not so easy for it to evaporate or get out. A waterproofing preservative will enter all these openings, easily making the belt waterproof as it was when new, rendering it more serviceable, and making it more waterproof every time an application of the preservative is made.

Even unpainted cotton belts properly treated are made waterproof, because there are no glued laps and because they are already filled with an impervious filler. The preservative readily penetrates between the fibers, mats them together, makes a heavier belt, more dense, with less stretch. The well stitched canvas belt made of plies of canvas is preferable to the woven webbing form of belt, as it stretches less and has more weight and density when waterproofed. A heavier belt is desirable because initial tensions can be readily reduced; if an initial tension is needed it is created by the weight of the belt itself.

The photographs given herewith show belts in actual operation in different plants, pulling loads that tax the full strength of the belts, yet with apparent ease. It is evident that a load pulled in this way reduces the shaft deflection to a minimum and thus increases the shaft's efficiency. The total pull is used in doing useful work. If the belt elongates, all the better; the arc of contact is increased, thus maintaining high belt efficiency.

All of these advantages, especially that due to waterproofing, are worthy of earnest study. There is much to be gained in improving boiler, engine, dynamo, and motor efficiencies, but unless belts are properly cared for, that gain is lost in the shafting and never gets to the machinery. Modern belt treatment, such as described here, is largely responsible for the high belt and shaft efficiencies found in the most carefully-planned shops of today.

NEW KIND OF SHEET PACKING

ENDURA sheet packing was gotten up to overcome the defects found in other packing when used under oil or similar conditions. Endura is a vegetable fiber, treated in such a way that it resists the softening and rotting effects of oil and water (hot or cold), acids, benzine or gasoline, coal-tar, brine, ammonia, etc., and at the same time, greatly increases its toughness and tensile strength, without adding greatly to the weight of the fiber sheet.

It is not recommended for steam or dry heat conditions but under moist conditions.

It has given perfect satisfaction for several years on the water end of mine pumps, where formerly the same pumps required frequent repacking on account of the hard condition of the water. It has given excellent results working under 4 per cent solution of sulphuric acid.

It is for these reasons that the manufacturer claims that Endura is an original improvement in the line of sheet packing.

INDUCTION MOTOR OF NEW DESIGN

TYPE C S squirrel cage induction motors have been designed recently and put on the market by the Westinghouse Electric & Mfg. Co. in all commercial sizes from 1 to 200 hp.

In these motors, rolled steel forms the frames of the sizes above 20 hp., the end plates of the smaller sizes and the feet and slide rails of all sizes.

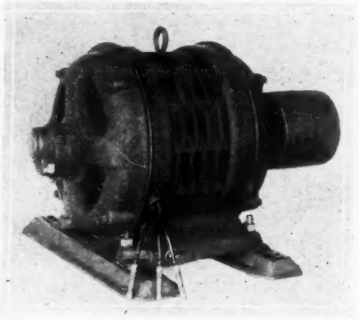


FIG. 1. NEW DESIGN OF INDUCTION MOTOR

Form-wound stator coils are laid in open slots, for motors above 5 hp. Rotor bars are insulated with a cement capable of resisting moisture and able to withstand a high degree of heat and mechanical stress. Short-circuiting rings around the ends of the bars form an electrical connection of great mechanical strength.

FIG. 2. STATOR OF TYPE CS MOTOR

Bearings are protected from dust by a cap at the front end and by felt washers between metal rings on the pulley end.

A high efficiency and power factor, not only at full but also at fractional loads, commend this motor for industrial uses.

PRESERVING OF FENCE posts may be accomplished by the use of a mixture of boiled linseed oil and pulverized charcoal mixed to the consistency of paste and a good coating applied with a brush and allowed to dry before the post is set.

THE COMBO REGULATING DEVICE AND RECORDING GAGE

IN the design of this apparatus a device has been sought of simple, compact and rigid construction, uniting a water column with whistle alarms, electric water gage, electric signaling and recording panel, and graduated feed-water regulator. Power for drying the system is secured from a float and the compound lever system contained within the main body, this mechanism being practically frictionless and having great power. Through connections to small hinged shafts, the motion is brought outside the main body and connected into the upper and lower heads.

Alarms, signaling gages and the whistles are mounted on the upper head; the lower head is used for the regulating mechanism. The main body is cast iron and the small heads are brass with levers of brass and aluminum. On the upper head a system of compound levers with slotted holes permitting of adjustment operates the whistle opening device for either high or low water and from the shaft lever extends the main contact lever with suitable electric contacts which are connected by wire to the signaling gage and recording panel operating the lights and the recording mechanism. All the working parts of the system are enclosed in a brass cage with glass front.

THE COMBO BOILER REGULATING AND RECORDING DEVICE

The lower end through a system of levers operates a special pilot valve which in turn is connected by brass piping to the feed valve in the feed water line. The pilot valve has 4 distinct regulating valves with tapered disc seats so that the regulating valve in the feed water line can be held at any position of opening by quarters from full closed to full open according to the water level and the amount of steam being used.

On the signaling and recording panel the lamps are mounted one above the other upon small plates, enclosed in a glass cylinder and wired to the electric contacts on the alarm head. This electric gage may be placed on the recording panel and a similar gage may be placed at any point in the boiler room. On the recording panel are lamps to indicate high and low water and a clockwork device carrying a chart, is energized from the electric contact on the upper head of the Combo device.

To install the Combo, 2 pipe connections only are needed, one above and one below the normal level, the same as for any standard water column. Attachment of any alarm or of the regulator is made direct to the main column and does not interfere with the column piping of the boiler.

The signaling and recording panel is designed to take care of the regulation of 4 boilers but it may be varied to care for any number of units. The feed valve can be installed at any point in the water line and is connected to the regulating attachment on the main water column by small brass pipes. The device gives whistles and also illuminating signals for high and low water, controls the water level by means of the regulator and also makes a complete record of when high and low water were reached, how long they continued, when the water column is blown down and all other features of operation which cause any change in water level.

The device is made by the Combo Engineering Company, Inc., of Union Springs, N. Y.

AMERICAN CONDENSERS IN JAPAN

THE almost incredibly rapid march of progress in Japan is well illustrated by the photograph herewith reproduced, which shows the Fushimi power station of the Kyoto Electric Light Co., Kyoto, Japan. In design and in appearance this station compares favorably with any of its size in this country, and while it is hard to fit power houses into the popular conception of the Flowery Kingdom, the photograph given is indisputable evidence of the forward strides which that country is making.

WHEELER BAROMETRIC CONDENSERS AT A JAPANESE CENTRAL STATION

The station was built in 1910, and is operated by native engineers in charge of Dr. T. Kogi, the chief engineer. The first generating unit consisted of a 1500-kw. vertical Curtis turbine furnished by the General Electric Co., and operating in connection with a Wheeler barometric condenser, air pump, and motor-driven centrifugal pump, all manufactured by the Wheeler Condenser & Engineering Co. The complete outfit was later duplicated. The photograph shows the 2 condensers, equipped with relief valves and entrainers.

SHEAR-KLEAN BOILER GRATES

IN these grates, which are made by the Marion Machine, Foundry & Supply Co., of Marion, Ind., there has been embodied not only a fore and aft shaking motion, but also an effective sidewise motion which gives a shearing and crushing action effectually removing noncombustible and clinker forming material from the fire bed without destroying the efficiency of the live coal fire above. Because of this efficient cleaning, it is found unnecessary to have the grate dump, as the fireman can handle and control his fires without the use of slice bar or poker.

Fingers of the grate bars are of the interlocking type which has been demonstrated to be effective, and are strong enough to crush anything which may accumulate in the boiler furnace. By means of a positive centering device it is impossible to get the shaking lever out of the socket in the shaking attachment until the grates are central and level, making it therefore impossible to burn the fingers of the grate bars. The grate bars are of special shape, designed to give proper air space, according to the size of grate and quality of fuel to be burned.

On the side bars washers are provided which rest against the furnace wall, thus holding the side frames up against the rollers on the grate bars. These rollers act against cams on the side frames and thus give the sidewise motion to every alternate grate bar, producing the shearing action. The sidewise moving bars have no hub on the journal clip castings, so that they can move endwise in their bearings. The other bars

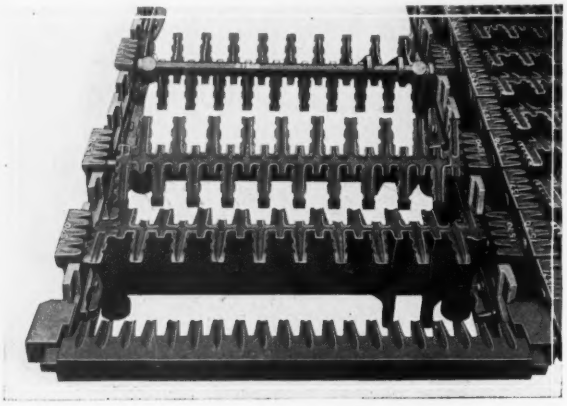


FIG. 1. PARTIAL ASSEMBLY OF SHEAR-KLEAN GRATE

have a hub on the side of the journal clip, keeping them always central between the side frames. These journal clip castings slip into the side frames from above and can only be removed by an upward pull so that they cannot be lifted out of position when the grates are actuated. The clip journal acts as a grate bar on top of the side frame and also as a bearing for the moving grate bar, thus protecting the side frames from heat and limiting frame expansion.

The Marion interlocking grate, made by the same company, has all the valuable features of the Shear-Klean, except the sidewise motion. The fingers are interlocking, are rounded at the ends so that a hoe or slice bar can be shoved over them without catching, have the center-locking device for the rocking lever, so that the fingers must always be left in a level position, and have the grate bars amply strong to crush the hardest clinker.

Figure 1, a partially assembled view of the Shear-Klean grate, shows the form of the grates, the position when rocked forward, the rollers on the bottom of grate bars, and the side cams which give the sidewise motion, the journal clip castings, and the places where they set into the side frames, and on the inverted bar at the back of the grate is shown the form of the bar which does not move sidewise, and also the journal clip casting with hub to centralize the bar. Figure 2 shows the front view of a furnace with Shear-Klean grate installation and the detail of the operating bar and the mechanism by which central position is assured before the lever can be removed.

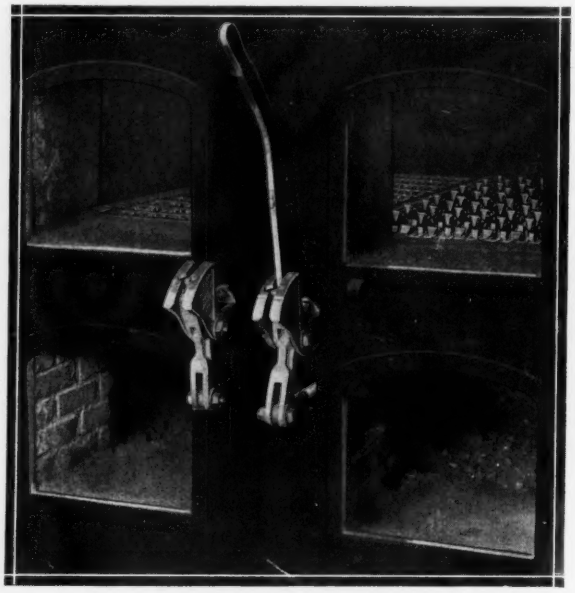


FIG. 2. FRONT VIEW OF SHEAR-KLEAN GRATE INSTALLATION

KANTKINK FLEXIBLE METALLIC HOSE

THIS hose, made by The Goodyear Tire and Rubber Co., of Akron, O., has many points of difference from the ordinary metallic hose, which make it worthy of consideration.

Inside is a regular hose tube, which carries the pressure and prevents heat, although the metallic surface itself is capable of withstanding pressure, even if the inner tube were not there. Outside is an interlocking metallic casing, completely covering the tube, and made without sharp or rough edges, yet so flexible that the hose may be tied into knots without injuring the outer casing, yet it cannot acquire the short kink which is so destructive to hose made of rubber alone. It, therefore, justifies its name, as it cannot make short kinks and yet is extremely flexible. Tests have shown that a pressure equal to 1000 lb. per square inch will not burst the hose, and in durability tests it has stood up to the most exacting requirements.

THE FALLS ENGINE STOP

IN its improved form, this stop consists of a valve of the rotary type, which is held out of contact with the casing until it reaches its extreme closed position, thus making the action frictionless. The valve is closed by a weight which is held in a horizontal position by a catch as shown in Fig. 1, the left-hand view being the exterior with the valve open, and the right-hand view, the interior. The valve shown is electrically operated, having a solenoid on the base of the valve, which trips the catch when contact is made by the speed limit band.

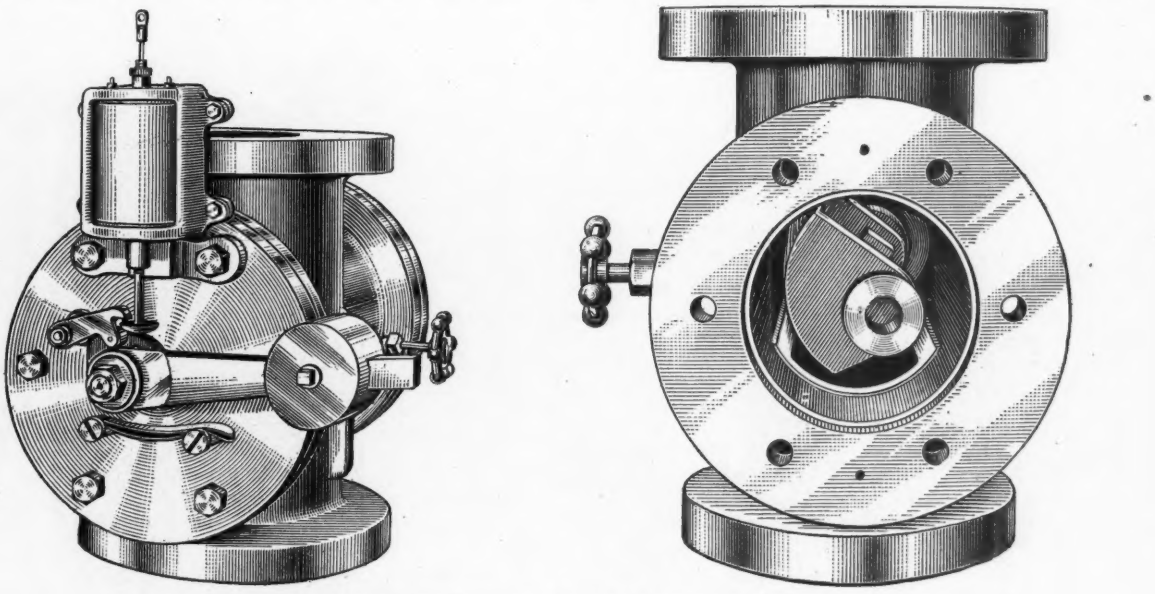


FIG. 1. EXTERIOR AND INTERIOR VIEWS OF THE FALLS ENGINE STOP VALVE, OPEN

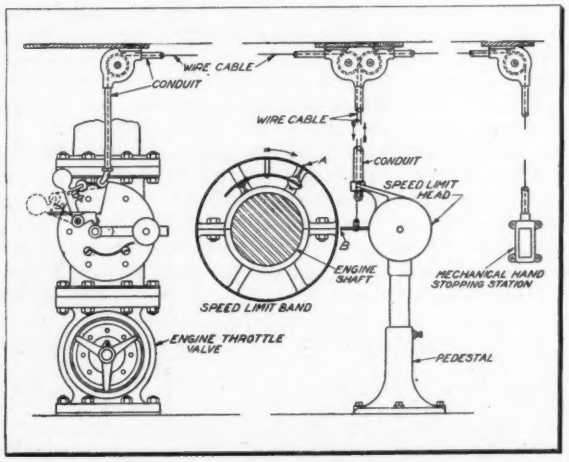


FIG. 2. ARRANGEMENT OF THE FALLS ENGINE STOP FOR MECHANICAL OPERATION

This band is mounted directly on the engine shaft, and is in the form of a split collar which is rigid and thus easily adjustable. Inside the band is a centrifugal weight carried on a spring, and when the engine gets above the speed limit, this weight flies outward, and either makes an electrical contact thus energizing the solenoid, or in the mechanical form of the stop, which is shown in Fig. 2, the rope is tripped and thus mechanically throws the catch on the valve.

Examination of Fig. 2 will show also, that if the rope breaks at any point between the speed limit band and the valve, the counterweight at the left will automatically close the stop valve and shut down the engine. Figure 3 is a sectional view of the valve head, showing the frictionless valve stem bushing. This is of noncorroding metal, pressed into the front head, and has a bevel seat against which the curved face of the collar on the valve stem rests. The 2 surfaces

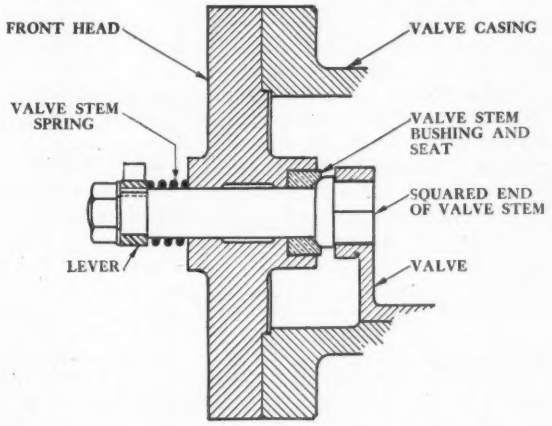


FIG. 3. SECTIONAL VIEW OF THE VALVE CASING, SHOWING THE VALVE STEM BUSHING

are lapped together, forming a steam tight joint, and the stem is held to its seat by the pressure of the steam on the inside of the square head. When the steam line is not under pressure, the stem is held to its seat by the spring shown in the illustration.

This stop is manufactured by the Falls Machine Co, Sheboygan Falls, Wis.

AMERICAN IDEAL STEAM TRAP

THIS is of the float type with water sealed valves and the valve operated by a system of levers which permit of floats of heavy construction. To give an idea of the leverage secured by the mechcanism, a weight of over 200 lb. can be lifted with a piece of linen thread tied to the lever in place of the float. As seen in the sectional view Fig. 1, the valve has a 2-bearing alinement with its seat and is protected from scale and dirt by a heavy screen. Also any sludge or sediment which may collect is drained off through a blowoff plug in the bottom of the chamber beneath the valve.

Looking at the sectional view Fig. 1, it will be seen that the position of float G is controlled by the water level in the trap; as this float rises it operates

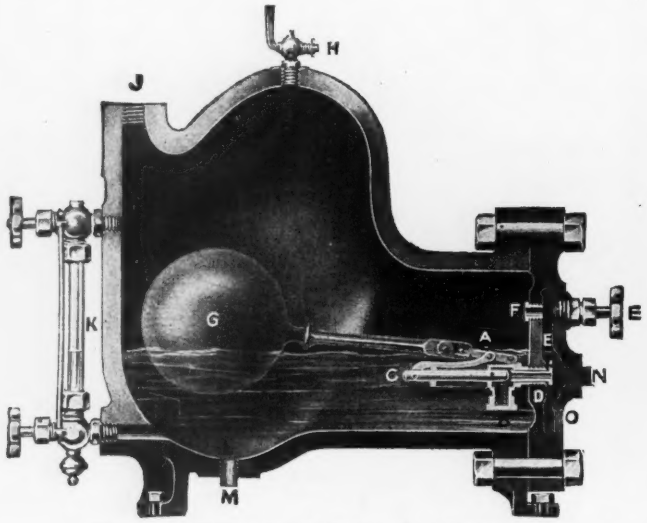


FIG. 1. SECTIONAL VIEW OF MODEL C TRAP

the toggle joint mechanism at A, moving the valve back from its seat and allowing water to flow up through the valve from the bottom through the strainer B and nozzle D to the outlet O. As the float falls with the water level, the toggle at A operates to pull the valve C forward to its seat and stop the discharge. The water gage glass at K indicates, always, the level of water in the trap and shows, therefore, the rise and fall and the action of the valve. A bypass F controlled by valve E is provided for blowing out the discharge pipe and for emergency use. Air is vented through the cock H and sediment blown off through the outlet M. The plug N is provided to permit of renewing the valve seat without disconnecting the trap or removing any parts of the casing. The trap is made in sizes from ½ in. to 2½ in., the discharge of the smaller being 4380 lb. an hour and the larger 35,000 lb. an hour.

For special conditions such as are encountered in paper making, steam cooking, etc., the Model D trap is provided. This has a tubular valve and a double toggle mechanism to permit the trap to operate from atmospheric pressure to the highest working pressures in steam practice, or on exhaust steam, without adjustment. The area through the tubular valve is the whole pipe size area of the trap. The valve is water sealed and has provision the same as Model C for renewing the valve seat through the opening of plug F. By means of the circular baffle plate L, water seal is provided at the inlet to the trap as well as at the outlet and the gage glass K shows the water level at all times. The regular sizes of this model are 1½ to 2½ in. Both styles are made by the American Steam Gauge and Valve Mfg. Co., 206 Camden St., Boston, Mass.

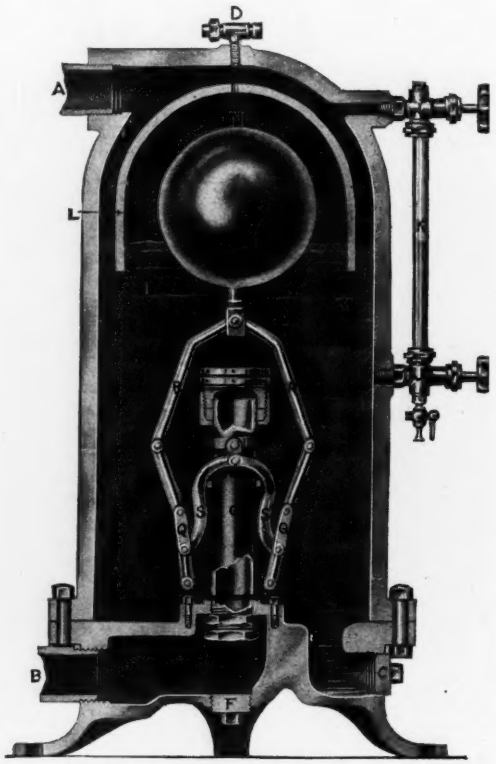


FIG. 2. SECTIONAL VIEW OF MODEL D TRAP

THE DECENNIAL CONVENTION of the Universal Craftsman Council of Engineers was held at the Brunswick Hotel in Boston, August 5 to 8. The meetings were devoted to the business of the organization to actions on reports and to the election of officers and choice of meeting place for 1914. Entertainment features of the meeting were a reception on Monday evening at the Hotel Brunswick, an automobile ride for the visiting ladies on Tuesday afternoon, a visit to Nantasket Beach on Tuesday evening, a reception on Wednesday afternoon, a boat and narrow gage rail trip to Revere Beach on Wednesday evening, on Thursday afternoon shopping and sight seeing for the ladies and on Thursday evening a reunion and entertainment given by Jenkins Bros., with Frank Martin as the director. The committee of arrangements for the meeting was Geo. W. Knowlton, Claude B. Allen and Wm. T. Judge.

The entertainment of Tuesday afternoon and evening was given to the members, officers and visiting ladies by the New England Association of Commercial Engineers.

A METHOD OF RUST-PROOFING idle machinery, which has been found extremely satisfactory under careful test, is given in Factory as follows: The machinery is cleaned and smeared with a mixture of one ounce of camphor dissolved in one pound of melted lard, mixed with enough fine black lead to give it an iron color.

NEWS NOTES

NEGOTIATIONS HAVE BEEN completed for the purchase of the New York and Queens Electric Light and Power Co. of a parcel fronting 300 ft. on Van Wyck Ave., and with a depth of 250 ft. just north of the new Long Island Railroad terminal at Jamaica, L. I. This property has been acquired for the establishment of a substation, executive offices and headquarters for the construction force of the company in the Jamaica district. Within a short time the company will commence the erection of a fine plant. The present plant of the company, located on the opposite side of the street from that purchased, was purchased by the Long Island Railroad for terminal purposes.

At this substation will be centered for the Jamaica district the power that will be transmitted both from the Long Island City and Astoria stations over the new trunk lines now building. In addition, the company will place underground the wires of the company in the Fulton St. section.

OWING TO THE RAPID GROWTH of the Elliott Co., Pittsburgh, its present works have been for some time entirely inadequate. It has recently purchased the works of the Clifford-Capell Fan Co. at Jeannette, Pa., and is now engaged in remodeling the buildings, and making them suitable for its regular line of business, and in addition is preparing to construct a new foundry, 300 by 150 ft.

The new works are located on 33 acres of ground adjacent to Jeannette, and the buildings already in place will represent an increase in floor space of about 2½ acres. The company expects to complete its improvements and additions to its new works by October, after which at least its heavier tools will be moved to that plant.

The Clifford-Capell Fan Co. has been manufacturing the Clifford fan for mine ventilation; this business will be continued by the Elliott Co.

PHILADELPHIA ELECTRIC CO. is planning to increase largely its plant and power capacity to cope with extensive demands made upon it by new business. A new substation, to cost $200,000, is about to be built at 65th St. and Paschall Ave. to distribute power to plants in West Philadelphia and Chester and Delaware Counties. A substation at Marcus Hook is to provide for the Viscose Co.'s silk manufactory at that place. Another new substation at Chester will furnish the power for the Chester Solid Steel Casting Co.'s rolling mill and other industrial plants. Besides, the company is going to enlarge materially its Christian St. plant, in which are to be placed next year 2 new turbo generators, which will produce one 47,000, the other 41,000 hp., altogether 88,000 hp.

AMERICAN ENGINE & ELECTRIC COMPANY, with offices and works at Bound Brook, N. J., announces that it has taken over the business of the American Engine Company, and will have increased facilities for the manufacture of the American-Ball high speed steam engines, whieh have been built by the latter company for the past 17 yr., as well as a complete line of electric motors and generators from the designs of W. T. Hensley, who is now associated with the company, and who has a wide experience in motor design.

The officers of the American Engine & Electric Company are as follows: Hugh C. Pierce, president and treasurer; Wm. T. Hensley, vice-president and secretary; F. O. Ball, general manager; F. H. Ball, consulting engineer.

THE PIEDMONT POWER CO., W. B. Lawrence, Engineer in charge, 18 Tremont St., Boston, proposes the construction of a hydro-electric plant developing 18,000 hp. in North Carolina. It is understood that this development will be undertaken about 2 miles below the narrows of the Yadkin river, near Albemarle, N. C., where Charles A. Armstrong, of Troy, N. C., was previously reported as securing options for capitalists contemplating an investment of approximately $2,000,000.

THE BIG POWER DAM to be built on the Tuolumne river at Modesto, Cal., is to be 175 ft. high and 400 ft. long at the crest. The site for this massive stone and concrete is just above the dam at the intake of the Golden Rock ditch. It is an ideal site for a dam, there being solid rock on both sides all the way across at a reasonable depth. No better site could be found—no other place where such a short dam will impound such an immense body of water.—Tuolumne Prospector.

L. F. MALLORY, formerly with the Taylor Stoker Co., has recently become connected with the B. F. Sturtevant Co., 50 Church St., New York City, which manufactures and sells the Riley Self Dumping Underfeed Stoker for the Sanford Riley Stoker Co., of Worcester, Mass.

THE NEBRASKA LIGHTING CO., of Plattsmouth, Neb., has concluded to make an entire change in its plant there and will rebuild the entire plant. Arthur Huntington, the engineer in charge of the rebuilding of the plant, will make his home in Plattsmouth while engaged in the work of reconstruction.

ROCHESTER, N. Y., RAILWAY AND LIGHT CO. recently asked permission of the fire marshal to build a generating plant to cost $30,000 on Brown's race. It will be of concrete, one story high, and will measure 37 ft. wide, 91 ft. long and 18 ft. high.

FREDERICK L. RAY, of Louisville, Ky., is being proposed, by a number of his brother engineers of that city, as candidate for National Vice President of the N. A. S. E., in the election at the coming convention in Springfield.

THE 7TH ANNUAL Convention of the Illuminating Engineering Society will be held in Pittsburgh, Pa., September 22 to 26. Full information in regard to the program and transportation can be had from J. B. Jackson, Secretary, 28 North Market St., Chicago.

THE TAXPAYERS OF JAMESTOWN, N. Y., recently voted in favor of expending $40,000 to enlarge and improve the municipal lighting plant, which has been in operation 20 yr., furnishing light and power for municipal and commercial purposes.

RINCON IMPROVEMENT CO., Corpus Christi, Texas, will develop 800 acres at Corpus Beach, the improvements to include 5,000,000 cu. yd. of filling, 50 miles of graded streets, etc., to cost about $250,000.

SUNDH ELECTRIC CO. of New York has established a Chicago office at 122 S. Michigan Ave., with Henry J. Kaufman as manager.

BEAVER RIVER POWER CO., has filed with the city clerk of Hailey, Ida., its formal acceptance of its franchise to supply electric current for Hailey.

A CONTRACT WAS CLOSED between the City of Brewton, Ala., and a firm in Atlanta whereby Brewton will have a new water and light plant, a complete sanitary system. Work will begin immediately.

THE BOARD OF TRUSTEES of the Louisiana Industrial Institute, Ruston, La., has provided for an extension of the present academic and industrial courses one year, and authorized the enlargement of the power plant and the erection of future buildings.

JOHN A. WALLS, engineer, of Baltimore, Md., is preparing plans and specifications for alterations and additions to the plant of the Pennsylvania Water and Light Co., at Holtwood, Pa. Plans will be ready for bids in the near future.

PLANS FOR A NEW POWER HOUSE with full equipment for the manufacture of electric light and power have been drawn by Feris Brothers of Osage, Iowa. The site of the proposed plant is 2 miles south of the city on the Cedar River. The expenditure will be $20,000.

THE GAULEY POWER CO., which was recently incorporated with a capitalization of $250,000 by interests in Charleston, W. Va., to develop hydroelectric power on the Gauley River, has applied to the State authorities for permission to construct dams to develop between 96,000 and 100,000 hp. There will be 5 dams in all, 2 on the Gauley River and 3 on the Meadow River. To carry out the project considerable tunneling will be necessary and it is said that when the work is completed it will be one of the largest hydroelectric developments in the State.

IN ITS CAMPAIGN to complete a subscription of $200,000 for the purpose of advancing the art of electrical development the Society For Electrical Development is to be assisted by the members of the Jovian Order. The former society is composed of firms interested in the increase of the use of electrical apparatus and machines, while the latter society is composed of individuals engaged in electrical selling and contracting and allied interests.

The Society for Electrical Development plans a national popular advertising campaign, for publicity, and the supplying of newspaper advertising copy, an educational campaign to teach architects and builders the advantages of complete electric equipment, and a campaign for personal harmony between representatives of different branches of the industry.

SEPTEMBER 18-20, the eighth annual convention of the Federation of Trade Press Associations will be held at the Hotel Astor, New York City. Thursday morning will be devoted to Business Promotion through Trade Press Efficiency; Thursday afternoon to an editorial symposium devoted to the Efficiency of the Editorial Departments of Trade and Technical Papers; also jointly a circulation symposium will be held, dealing with problems of Increasing the Circulation of papers. Friday, Sept. 19, will begin the day with an advertising symposium devoted to questions of the value of advertising, good advertising copy, and the methods of handling advertising; this will be followed by stories of the development of the large papers in trade and technical fields, told by the men who have been instrumental in achieving such developments. Friday afternoon there will be addresses by a number of editors, publishers and advertisers on topics of general interest to their departments. In the evening a banquet will be held in the Hotel Astor North Ball Room, at which Postmaster General Burleson, Secretary Redfield, John Kendrick Bangs and other noted speakers will be present.

THE UNITED STATES CIVIL SERVICE COMMISSION announces an examination for electrometallurgist, for men only, to fill a vacancy in this position in the Bureau of Mines, Department of the Interior, for service in the field, at a salary ranging from $1800 to $3000 a year, and vacancies as they may occur in positions requiring similar qualifications.

Competitors will not be assembled at any place for examination, but will be rated on the following subjects: General education and scientific training; practical experience and fitness; publications or thesis.

Persons who desire this examination should at once apply for Form 304 and special form to the United States Civil Service Commission, Washington, D. C.

THE UNITED STATES CIVIL SERVICE COMMISSION announces an examination for examiner of surveys, for men only, on September 17, 1913, to fill 2 vacancies in this position in the Forest Service, Department of Agriculture, for service in the field, at entrance salaries ranging from $1200 to $1500 a year, and vacancies as they may occur in positions requiring similar qualifications.

Competitors will be examined in the following subjects: Practical questions on surveying and land laws; general and technical education and training; land-surveying experience and fitness.

Persons who desire this examination should at once apply to the United States Civil Service Commission, Washington, D. C., for Form 1312.

THE UNITED STATES CIVIL SERVICE COMMISSION announces an examination for assistant engineer in forest products, for men only, on September 17 and 18, 1913, to fill vacancies in the Forest Service, for duty at Madison, Wis., and elsewhere as they may occur, at salaries ranging from $1200 to $1500 a year.

Competitors will be examined in the following subjects: Technique of drying, treating, and testing timber; mechanics and mathematics (mechanics, elementary laws and problems with special reference to flexure of beams under static and impact loading, elementary hydraulics; mathematics to and including elementary calculus); drafting, and machine and structural design; education, training, experience, and fitness (including undergraduate education and training, postgraduate training, university education, or other training of a similar nature, and practical experience in research or industrial work).

Persons who meet the requirements and desire this examination should at once apply to the United States Civil Service Commission for Form 1312.

BOOK REVIEW

THE 4TH EDITION of Gebhardt's "Steam Power Plant Engineering" is just from press, and has been entirely rewritten and reset. This is one of the best of standard books, both as a text and reference work, on power plant practice, and deserves the great success that it has had. It contains 989 pages, 605 illustrations, and covers the entire plant, from the subject of fuels and combustion through to the rules for making tests of complete power plants. The chapter on finance and economics is especially valuable and interesting, as showing current practice in plant cost accounting, and forms for record charts, and the results in cost of operation. The price of this edition is reduced to $4 net.

THE GAS-ENGINE HANDBOOK, Seventh Edition, by E. W. Roberts, 323 pages; 4¼ by 7; 85 illustrations; indexed. 1913. Cincinnati, Ohio, Price, $2.00

This is a fully rewritten edition of this well-known work, which made its first appearance in 1900. In this edition, the author has given the reader the advantage of added experience and has treated the subject from the

standpoint of the latest practice. A comparison of this with the earlier editions shows that while there is much that is new in gas engine practice, the formulas originally published on design have been changed to a very small degree and in the main only so far as is required by the advance in the materials of construction.

The book has its chief interest in the fact that it is practical rather than theoretical. Where formulas of more than ordinary difficulty are employed, their use is explained in detail by means of a practical example.

Taking the book briefly in detail, it is divided into 3 separate parts. The first part is descriptive, the second deals solely with design, and the third gives general information on the installation, care and selection of gas and gasoline engines.

In the descriptive portion the author does not appear to have followed the conventional method of copying from catalogs and the use of catalog cuts, but illustrates the parts by means of original drawings and original descriptive matter. We find separate chapters on automobile motors, marine motors and aeronautical motors.

In the section on design the discussion starts with a chapter on the indicator diagram, and in another chapter shows the method of arriving at the general dimensions of a motor desired to fulfill certain conditions. Then follow chapters on the design of the specific parts such as the cylinder, the piston rods, shafts, etc.

Of more than ordinary interest is the chapter on the design of 2-cycle engines. It gives not only the formulas for design but shows that instead of being a puzzle the design of the 2-cycle is a simple matter.

In the third part a chapter on installation describes the arrangement of the engine room and gives many useful and practical hints on the arrangement of piping, cooling tanks, meters, etc., and goes into the whole matter of engine room fittings in a thorough manner.

The chapter on installation is followed by others on starting and stopping, care of gas engines and troubles. The latter is arranged under various heads and gives both the cause of the trouble and the remedy.

The chapter on testing describes in detail the method of making a complete test to the extent of a thermal analysis or the determination of a complete heat balance. A form for a test log and another for a test report make the treatment of this important subject, most complete.

The book ends with a chapter on the selection of a gas engine, which is well worth reading by the intending purchaser of a power plant.

"HEATING AND VENTILATING a Large Factory" and "Heat Transmission through Building Walls of Corrugated Iron" are the titles of 2 articles which the Green Fuel Economizer Co., of Matteawan, N. Y., has reprinted from Iron Age and Engineering News, respectively, for gratuitous distribution.

The first describes the hot-blast heating and ventilating outfit utilizing exhaust steam installed by this company in 2 large concrete and glass buildings, aggregating 2,400,000 cu. ft. of the Lee Tire & Rubber Co., of Conshohocken, Pa. The conditions were exceptional as regards the proportion of window surface, the size of the rooms and the rapid change of air required, but were successfully met by the equipment here described and illustrated.

Full particulars are given of all data and calculation. The second article reproduced in this pamphlet describes some tests made upon the hot-blast heating equipment of the fan shop of the Green Fuel Economizer Co., which is a steel-frame building covered with corrugated iron. The actual heat transmission found is compared with figures deduced from various data and formulae as given by Rietschel, Grashof, Woodbridge and others, with which it is found in substantial agreement. The details of construction of the building are fully described and the general arrangement of apparatus, exposure of the building, etc., are shown by drawings and photographs.

CATALOG NOTES

WAGNER ALTERNATING CURRENT rectifier is the subject of a circular from Wagner Electric Mfg. Co., 6400 Plymouth Ave., St. Louis, Mo.

DETROIT LUBRICATOR CO., of Detroit, Mich., has issued a 56-page catalog, No. 36L., on locomotive lubricators, giving instructions for operation and installation.

HUGHSON STEAM SPECIALTIES are described and illustrated in a 40-page catalog recently issued by Hughson Steam Specialty Co., 5021-23 So. State St., Chicago.

ELEVATOR SERVICE is the name of an interesting and informing booklet received from the Otis Elevator Co., giving hints on the care and operation of elevators of all types.

SPRAGUE FLEXIBLE STEEL-ARMORED HOSE for railroad service is described and illustrated in Catalog No. 521 from Sprague Electric Works of General Electric Co., 527-531 West 34th St., New York.

FUEL OIL DATA, a 20-page booklet from Tate, Jones & Co., Pittsburgh, Pa., contains matter of interest to fuel users, particularly those using it for metal heating, tempering, etc. Copies may be obtained by addressing the company as above.

JEFFERSON UNION CO.'S ninth "Makers of Unions" folder deals with Abraham Lincoln, who, when it came to the test, showed of what metal he was made.

The fitness of Jefferson unions likewise to stand tests and win respect is emphasized. Several styles of unions are illustrated.

A COLLAPSIBLE OIL FILTER is the title of a publication issued by S. F. Bowser & Co., Fort Wayne, Ind., discussing its oil filtering and circulating systems.

The company has also prepared a series of 3 circulars for sending to power plants and factories. Copies of any of these may be obtained by anyone desiring them.

BULLETIN A4139, just issued by the General Electric Co., is devoted to central station oil switches of high rupturing capacity. The switches are made both automatic and nonautomatic, and for voltages from 15,000 to 70,000. The bulletin describes the switches in detail, and contains a list of central stations in which these switches are in use.

THE GENERAL ELECTRIC CO. recently issued Bulletin A4129, which illustrates and describes in considerable detail that company's small feeder voltage regulators. This regulator is of the pole type and is built for use on single-phase feeders only. It is made in 2 designs, one for outdoor installation and automatically operated, and the other for hand operation, and to be installed indoors only. The bulletin contains internal and external views, connection and dimension diagrams.

NEW CIRCULARS from Kingsford Foundry and Machine Works, Oswego, N. Y., describe the company's high-pressure turbine pumps for lifts up to 500 ft., and double flow pumps for lifts up to 150 ft. A cross section shows the general construction of the latter. The

housing consists of shell and 2 heads, of such design as to form a unit tested for 100 lb. hydrostatic pressure. The impellers are made of cast iron for moderate duties and speed, of bronze for higher requirements, and are so effectually balanced that they may be said to float in the liquid surrounding them.

MASON REGULATOR CO., Boston, Mass., has just issued its General Catalog No. 60, which is said to be the largest and most complete catalog ever given to the presentation of pressure reducing devices. It contains 220 pages with 100 or more illustrations, many of

them being sectional cuts, to illustrate more clearly the construction and operation of Mason valves. Special pains have been taken, also, to make the descriptions clear and complete. The book is beautifully printed in 2 colors, the cover design being shown in the reduced reproduction herewith. The company will gladly send a copy of this book free to any engineer on request.

WHAT IS YOUR BOILER SCALE PROBLEM? is the question asked in a folder received from the United States Graphite Co., of Saginaw, Mich. It is an attractive piece of printing, and has surprises in store for the reader as he opens it. It shows what Mexican boiler graphite has done in removing scale and preventing the formation of new scale, and also gives a convenient postcard for the obtaining of further information.

THE GENERAL ELECTRIC CO., has just issued Bulletin No. A4124, devoted to a detailed description of its automatic starters for alternating current motors. The bulletin describes automatic control panels for squirrel cage induction motors and slip ring induction motors, float switches for remote control of automatic starting panels or rheostats, and pressure governor panels, also for remote control.

VEEDER COUNTERS, including the company's new setback and locked wheel counters, are described and illustrated in Catalog No. 109 from the Veeder Mfg. Co., Hartford, Conn. These are suitable for any purpose requiring a small, light and accurate instrument to register the number of pieces or quantity of material produced.

"MARION SHEAR-KLEAN Line of Boiler Grates" is the title of a 24-page catalog just received, which describes these grates, with illustrations showing different positions and the parts in detail. Marion interlocking and rocker grates are also illustrated. The manufacturer is the Marion Foundry & Supply Co., Marion, Ind.

INDESTRUCTO FIRE TOOLS, of standard pattern, but made of a composition metal designed to withstand the hard use to which such tools are subjected under high temperature, are described in a circular from The Indestructo Fire Tool Co., 25 Sellers Ave., West Philadelphia, Pa.

BULLETIN NO. 246 has recently been issued by Sprague Electric Works of General Electric Co., 527-31 West 34th St., New York. This bulletin supersedes Nos. 235 and 310, describing and illustrating motor-driven exhaust fan outfits, direct and alternating current.

"ELEVATOR SERVICE," a booklet from Otis Elevator Co., 11th Ave. and 26th St., New York, contains some useful information for the engineer regarding the care and operation of elevators. Otis lubricants for various purposes and the Otis controller parts cabinet are described.

HEREWITH WE ILLUSTRATE the front cover of an interesting catalog of steam specialties, which describes in detail the construction and action of the Boylston valves and other devices, including special regulating valves of diaphragm, lever and spring loaded types, for high and low pressure, reducing valves, back-pressure valves, the Boylston steam trap, which is of float type, pump regulators, water sprays for vacuum lines, tank valves, hot water temperature regulators, steam separators and grease extractors.

The book contains 96 pages of interesting illustrations and description, and tables of useful information. It is issued by the Western Kieley Steam Specialty Co., 116 West Illinois St., Chicago, and is known as General Catalog No. 10. It will be sent to all readers who mention Practical Engineer in writing for it.

INGERSOLL-RAND CO., 111 Broadway, New York, has issued a 140-page general catalog of its compressors, drills, pumps and other products, citing individual bulletins for fuller information in each case. Compressed air tables and other tables and curves are also given under the head of useful information.

POINTS OF superiority of the Connecticut turbine, manufactured in sizes 25 to 500 hp., for any speed, are given in an advance sheet of the catalog issued by Connecticut Turbine Mfg. Co., New London, Conn.

STEAM POWER PLANTS is the title of an unusually attractive 42-page booklet recently published by Lockwood, Greene & Co., Boston. It describes in detail the construction and equipment of a few of the many power plants designed by this concern.

A MODEL OF a seatless blowoff valve is being distributed by Yarnall-Waring Co., Chestnut Hill, Philadelphia. The circular explains the operation of the valve, giving several distinctive features. These models may be obtained by writing to the company, mentioning Practical Engineer.

BULLETIN No. A4113, entitled "Oil Switches for Small Capacity Industrial Application," and recently issued by the General Electric Co., illustrates and describes that company's oil break switches, known as Type F, Forms P3 and P6. It supersedes the company's previous bulletin on this subject.

THE SUCCESSFUL USE of Cling-Surface in Railroad Shops is the title of an 8-page booklet issued by the Cling-Surface Co., Buffalo, N. Y. It illustrates examples of the benefits of Cling-Surface in 5 prominent railroad shops and describes every installation in detail. On the last page over 40 big railroads are listed which use this treatment. A free copy will be sent on request.

GREENE, TWEED & CO., 109 Duane St., New York, has recently issued a booklet showing some of the prominent buildings in and around New York City, where Rochester automatic lubricators are installed.

The same company has issued a circular relating to Empire lace cutters, which can be adjusted to cut any width lacing from 3/16 to 3/4 in.

THE NEW CATALOG No. 20, issued by the L. S. Starrett Co., a most complete catalog of mechanics' fine tools, is the 20th edition and is a large book containing some 320 pages of interesting descriptions, illustrations, and prices for all kinds of tools for machinists, carpenters, draftsmen, engineers, chauffeurs, and other mechanics. In addition there will be many pages of data and tables such as metric conversion tables, decimal equivalents, weight computing tables, tapers and angles, wire gage tables, etc.

FROM THE BRISTOL CO., Waterbury, Conn., we have recently received several preliminary bulletins on thermometers and pyrometers. Bulletin 175 contains illustrations and descriptive matter about a new line of electrical resistance thermometers. Bulletin 176 contains a few new illustrations of Bristol pyrometers. Bulletin 178 describes and illustrates the company's wet and dry bulb recording thermometers recently designed for recording temperatures of wet bulb and dry bulb on the same chart on the basis of which the humidity of the air can be computed.

THE GENERAL ELECTRIC CO. has recently issued a bulletin (No. A4130), descriptive of its adjustable speed direct-current motors. These are designed to meet the requirements of individual drive of machine tools. The bulletin illustrates these motors and their application in considerable detail, and contains various curves showing the horsepower outputs at speeds of 300 to 900, 400 to 1200, 500 to 1500 and 600 to 1800 r.p.m. and the horsepower each motor will develop at intermediate speeds.

Bulletin A4093, from that company, illustrates and describes its generators for electrolytic work, and supersedes its previous bulletin on that subject.

"ELECTRIC ARC WELDING APPARATUS," gives a complete description of a new multiple unit arc welding outfit, by means of which several operators can work from the same machine, use either graphite or metallic electrodes and perform all kinds of welding operations by means of the electric arc. The automatic features of this outfit by means of which this flexibility is made possible are also fully described. Over 30 interesting photographs are given showing applications of the C & C outfit. Curves are also included, showing the efficiency of these sets and the cost of operating them as compared with other forms of electric welding. Copies of this catalog can be had by addressing the C & C Electric & Mfg. Co., Garwood, N. J.

THE BUREAU OF MINES has copies of the following publications for free distribution, but can not give more than one copy of the same bulletin to one person: Technical Paper 37—Use of heavy oils in internal-combustion engines, by I. C. Allen, 36 pp.; Technical Paper 44—Safety electric switches for mines, by H. H. Clark, 1913, 8 pp.; Technical Paper 49—The flash point of oils, methods and apparatus for its determination, by I. C. Allen and A. S. Crossfield, 15 pp.; Report of the Mine Inspector for the Territory of Alaska for the fiscal year ended June 30, 1912, 24 pp.

Requests for all papers cannot be granted without satisfactory reason. In asking for publications, please order them by number and title. Applications should be addressed to the Director of the Bureau of Mines, Washington, D. C.

RECEIVER SEPARATORS for installation in the steam lines to engines and turbines are described in section "B" of the Cochrane Separator Catalog, just issued by the Harrison Safety Boiler Works, 3144 N. 17th St., Philadelphia, Pa. This pamphlet describes high-pressure steam separators equipped with wells or receivers of large capacity for the purpose not only of storing exceptional amounts of water, such as might be lifted from the boiler by priming or foaming or be formed by condensation in the pipe line, but also to serve as a reservoir for the storage of steam between the intervals of opening of the engine admission valve. It is stated that by installing a steam separator adjacent to the engine of about 3 times the volume of the high-pressure cylinder, shocks and pulsation in the steam line can be avoided, and a much higher velocity of flow is permissible, making it possible to use smaller steam piping and fittings, thereby lessening standing charges due to first cost, and also loss of heat by radiation. A chart is given by which the most economical diameter of piping may be ascertained, assuming uniform flow, as where receiver separators of large capacity are installed.

TRADE NOTES

AS AN INDICATION of the prosperity which is attending many manufacturers, some of whom are almost overwhelmed with business, the Terry Steam Turbine Co. of Hartford, Conn., has just started operating on a 23-hr.-a-day basis. The one hour of idleness is from 6 to 7 in the morning which is found necessary for clearing up and cleaning out. The 23-hr. work is essential to clear the shop from the present crowded condition due to the great number of orders during the past few months.

GENERAL SATISFACTION is the keynote of letters given by the Yarnall-Waring Co. in one of the bulletins which it sends out to its salesmen. These bulletins contain records of sales, letters received from users, and

interesting notes about the performance of the Simplex Seatless Blowoff Valve, and the endorsements come all the way from Louisiana to Minnesota, and from Massachusetts to Kansas. Especially interesting are the reorders of these valves by the companies which have had them in use for some time, some of these coming from Cleveland Electric Illuminating Co., Brown & Sharpe Mfg. Co., Baldwin Locomotive Works, S. D. Warren & Co., The U. S. Navy Dept., Proctor & Gamble Co., John A. Roebling's Sons Co.

FOR THE INFORMATION of its salesmen, Nelson Valve Co. issues a series of bulletins, called Latest News on Nelson Valves. These bulletins show the recent sales that have been made, both the retail sales on large contracts, and the sales to supply houses and wholesalers.

Some interesting points in a recent bulletin are the statement by one of the New York Edison Co.'s engineers, that the Nelson steel valves for superheated steam, in the Waterside plant in New York City, are giving entire satisfaction. Also, on a test of valves built for 125 lb. pressure, a 6-in. valve cracked only when the pressure had been raised to 1500 lb., and an 8-in. held up until the pressure reached 1350 lb., both valves being taken from the stock room without examination in any way before testing.

THE KERR TURBINE COMPANY, Wellsville, N. Y., reports the largest volume of business in its history. Recent shipments of Economy turbines are as follows: 4 800-hp. turbines for driving 25,000,000-gal. pumps, Chicago Water Works; an 850-hp. turbine for similar service at Nashville, Tenn.; 2 100 and 2 150-kw. turbo-generator sets for Republic Coal Co., Roundup, Mont.; 2 35-kw. generator sets for the steamship Washington Irving; 3 75-kw. sets for the new steamship Seeandbee for Great Lakes service; 4 turbo-pump units for Swift & Co., 2 for Detroit General Hospital; 2 for Pittsburgh Crucible Steel Co.; 2 for Carnegie Steel Co. Recent export orders have also been received from England, Sandwich Islands and India. Also 16 turbines have just been ordered by one of the largest pump builders in the country. The company has just developed its first 500-kw. alternating current unit and is now better prepared than ever before to serve its customers with larger electrical units.

AMERICAN ENGINEERING CO., of Philadelphia, reports the following recent orders received by the Taylor Stoker Co. for Taylor stokers:

The New York, New Haven & Hartford R. R. Co., Van Nest, N. Y.; the Proctor & Gamble Co., Ivorydale, Ohio (large repeat order); the Proctor & Gamble Co., Port Ivory, N. Y.; State Hospital for the Insane, Rochester, Minn.; the United Illuminating Co., Bridgeport, Conn. (repeat order); Detroit Central Heating Plant, Detroit, Mich. (repeat order); Cleveland Municipal Light Plant, Cleveland, Ohio; Commonwealth Ice & Cold Storage Co., Boston, Mass.; the Atlantic Sugar Refineries, St. Johns, New Brunswick; the Mechanical Rubber Co., Cleveland, Ohio; National Quality Lamp Div. of General Elec. Co., Cleveland, Ohio; the Kansas Chemical Manufacturing Co., Hutchinson, Kansas; the Detroit City Gas Co., Detroit, Mich.; the Interborough Rapid Transit Co., New York City (repeat order); Elmira Water, Light & Railroad Co., Elmira, New York (repeat order); Schaum & Uhlinger, Philadelphia; the American Sheet & Tin Plate Co., Cleveland, Ohio; Edison Electric Illuminating Co., Lancaster, Pa, (repeat order); the Detroit Edison Co., Detroit, Mich. (repeat order); Wm. Cramp & Sons S. & E. Bldg. Co., Philadelphia.

PRACTICAL ENGINEER

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Any advertiser is invited to examine our paid subscription lists and Post Office mailing receipts at any time.

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Full page, one year, each insertion, $60.00.

Half page, one year, each insertion, $35.00.

Quarter page, one year, each insertion, $20.00.

Eighth page, one year, each insertion, $12.00.

Front cover, $150.00 per issue.

Other specified positions, regular rate plus 10 to 50 per cent.

Stippled plates used but no heavy black and white plates.

Invoices are rendered monthly and subject to 2 per cent discount within 10 days.

Classified Rates

Per line, 30 cents each insertion.

Advertisements in this section are inserted under regular headings.

No display type allowed, but the first three words may be set in capital letters.

About nine words make a line. Minimum space sold, two lines.

Under classification "Position Wanted," advertisements not exceeding four lines will be inserted once for subscribers free of charge.

All copy should be received at Chicago office 18 days before date of publication.

Circulation of this issue, 22,500

Technical Publishing Co.

537 S. Dearborn Street

Chicago

Positions Wanted

POSITION WANTED—As mechanical draftsman and designer. College graduate, mechanical engineer. Completed two correspondence courses in drawing. Over year's practical drafting. A-1 references. Edward Skillman, Tribune, Kansas. 8-15-2

POSITION WANTED—Watch Engineer in medium sized hydro-electric and reciprocating engine plant, desires position as chief in a similar plant. Good references. Liberal education and experience. Address Emerson B. Tifft, Box 606, Broad Brook, Conn. 8-15-2

POSITION WANTED—By first-class Steam Engineer. A. and D. current. Can give results and best of reference. Sober and steady, 14 yrs.' experience. Address Box 309, Practical Engineer, Chicago, Ill. 8-15-2

POSITION WANTED—Swedish, age 30, journeyman blacksmith with 6 years' experience as master mechanic in large sprinkler and steam supply house and 4 years' experience in repairing steam and gasoline engines. Wish position as master mechanic or general foreman with a sprinkler and steam supply or automobile firm. Address H. E. Wackeline, Natic Ave., Greenwood, R. I. 8-15-2

POSITION WANTED—As Chief Engineer on or about September 15, 1913. Age 40 yrs., with 25 yrs. Practical and Theoretical training, 5 yrs. with present employer. First class New York License. Own Indicator and a good set of tools. Address Box 311, Practical Engineer. 8-1-3

POSITION WANTED—As Electrical Engineer; at present in charge of large electrical plant in New York. 12 years' technical and practical experience. Strictly sober and industrious. Address William MacInally, Pleasantville, N. Y. 8-15-1

POSITION WANTED—As Engineer in small plant, or assistant in a large plant, by man of 28 yrs. No bad habits, 3 yrs. machinist experience; understands A. & D. current; holds local engineers' license. C. H. Freeman, 57 North St. Elgin, Ill. 9-1-1

Wanted

MANUFACTURER'S REPRESENTATIVE, favorably known and of wide experience in modern engineering, wishes to handle power-plant equipment, engines, boilers, stokers, etc., in Pittsburgh district. Daniel Ashworth, M. E., 1225 Fulton Bldg., Pittsburgh, Penn. 7-15-4

WANTED—We want copies of the April 1st, 1913, number of Practical Engineer. We will extend your subscription three months if you will send us a copy in good condition before September 8th, 1913. Practical Engineer, 537 S. Dearborn St., Chicago, Ill.

WANTED EVERY ENGINEER to have our pamphlet for setting valves on Corliss Engines, simple and compound, with one or two eccentrics. Sent free. Lindstrom's Machine Works, 200 South Third St., Allentown, Pa. tf.

WANTED—ALL STEAM USERS to have clean boilers without using compounds or chemicals in any form. Write "Otis," No. 317 Norfolk Ave., Buffalo, N. Y. tf.

IF YOU ARE a night engineer, spend a few hours each day taking subscriptions for Practical Engineer. You will be paid well. Write Subscription Dept. They will start you in at once.

Help Wanted

WANTED—Live wire specialty salesmen, district managers in West, Middle West and South to sell the Schemmel Welding and Cutting Machine, which is self-generating and is the best on the market. Right men can make ten thousand dollars annually. Reference required. Must finance yourself. Full particulars first letter. Confidential. Davis Sales Co., Holliday Bldg., Indianapolis. 9-1-1

WANTED—Good Live Agent to handle well established Oil Engine for Illinois and surrounding territory. Address Box 315, Practical Engineer. 9-1-1

For Sale

FOR SALE—One 125 hp., three cylinder, producer gas engine, without producer. Can be changed to use coal gas or natural gas. One six-inch Hill line shaft 40 feet long, with pulleys, clutches, etc., same as new. Board of Public Works, South Haven, Mich. 9-1-2

FOR SALE—One Northern Electric generator, volts 250, amperes 120, K.W. 30, speed 1000, No. 24110, equipped with a 14½" x 9½" iron pulley.

Switch Board. 16" x 48" x 1½" black slate panel with ⅜" bevel edge; one combination 2 P.S.T. 200 amperes, 250 volts, D.C. knife switch and fuse holder; one four (4) point receptacle and plug; one Fort Wayne volt meter, on swing bracket, 0-400 volts; one Fort Wayne ammeter, 0-200 ampere; one single lamp bracket with black enamel half shade; two indicating lamps; two fuse blocks and one resistance for Fort Wayne volt meter, mounted on back of board; one rheostat mounting and one rheostat for generator.

Feed Water Heater. Wickes type, height 6' 6" x 38" diameter, exhaust inlet 6", cold water inlet 2", pump suction outlet 3", blow off 2½", regulator valve 2", float overflow and trap 3". Mounted on three 15" cast iron legs. Has been operating successfully on load of 300 H.P. Address Chicago Retort & Fire Brick Co., Office 832 Com. Nat. Bank Bldg., Chicago.

Patents and Patent Attorneys

PATENTS THAT PROTECT AND PAY. Advice and books free. Highest references. Best results. Promptness assured. Send sketch or model for free search. Watson E. Coleman, Patent Lawyer, 624 F Street, Washington, D. C. tf

PATENTS—H. W. T. Jenner, Patent Attorney and Mechanical Expert, 606 F St., Washington, D. C. Established, 1883. I make a free examination and report if a patent can be had and the exact cost. Send for full information. tf

PATENTS—C. L. Parker, Attorney-at-Law and Solicitor of Patents. Patents secured promptly and with special regard to the legal protection of the invention. Handbook for inventors sent upon request. 186 McGill Building, Washington, D. C. tf.

THE PATENTOME is interesting and instructive. A liberal education in patents and how to get them. Free on request. Establish, 1865. Anderson and Son, Patent Solicitors, 710 G St., Washington, D. C. 9-1-2

PATENTS SECURED. Legal protection our specialty. Booklet free. Harry Patton Co., Suite 330, McGill Building, Washington, D. C. tf.

PATENTABLE IDEAS WANTED—Send for 3 free books. R. B. Owens, 28 Owens Bldg., Washington, D. C.

Educational and Instruction

ENGINEERS' POCKET MANUAL. 175 pages, edited by University of Tennessee, will be be mailed every subscriber sending in one new subscription to Practical Engineer. Gild edges, bound in leather.

Miscellaneous

IF YOU ARE an operating engineer, we know the Fetta Hot Process Water Purifier will interest you. We would be glad to have your request for further information. Address the Fetta Water Softener Co., Richmond, Ind. tf.

ENGINEERS—DO YOU WANT to utilize your exhaust steam for heating or dying purposes, without back pressure on your engine? If so, address Monash Engineering Co., 1413 W. Jackson Blvd., Chicago, Ill.

MAKE MONEY on the side. Here's your chance to work out some money for yourself. Get subscriptions for Practical Engineer. It pays well. Just drop a line to the Subscription Dept. They will tell you. tf.

Sparks On The Advertising Pages

We all recall the man who, when the subject of advertising is mentioned, impatiently exclaims "I pay no attention to advertising. It never did me any good."

Isn't it an absurdity for anyone to make this statement, in this era when our habits, our food, our work, and our recreation is influenced by the printed page?

Consider the habits of a composite average man of 1913.

He arises to the tune of an alarm clock. (*We were educated to its use by advertising.*) He removes his beard by sprinkling powder on a brush, rubbing it into a lather, then scraping his face with a hoe-like arrangement. (*The use of the Shaving Powder and Stick, and Safety Razor was created solely by the educational advertising of the manufacturer.*) At his breakfast, he eats a prepared flaky cereal or a grape fruit. (*Educational advertising campaigns forced them on to the American appetite.*) On his way to work, he passes the minutes by reading the *street car cards,* and he ascertains if he will reach the office or shop on time by glancing at *the clock on the advertising billboard.* If, during the day, he feels thirsty he drinks Appollinaris, Grape Juice, Coca Cola or one of a dozen or more other drinks. (*Taste for which was cultivated by the advertising man.*) At home, in the evening, he fills his calabash pipe with a cut plug tobacco, (*the advent of both articles was prepared for by advertising*), has a good smoke while he reads the baseball scores, (*the interest in this game has been stimulated to its present great proportion largely by the amount of free advertising given it by the American press*). And, when he retires he throws all windows wide open, (*due to the fresh air advertising of various health committees*), and slumbers on a wire spring sanitary mattress, (*which has displaced the featherbed, and "shuck" tick because of the mattress makers' effective advertising*).

As a still further illustration, suppose that twenty years ago some one had told this man that ice cream would soon be an accepted winter food for the American people. The statement would have been received with credulity equal to that of "the moon is made of green cheese."

The man, state or nation not influenced by advertising is rare indeed. Religion, Health, Pleasure, and Learning are interdependent with this peculiarly 20th century Science.

Probably, one of the most illuminating examples of the effect of advertising on the habits of a nation was recently cited by a Standard Oil official.

"It seems that some years ago there was a town in China with a population of about 500,000 which had no lighting facilities. As they had no lamps, all the people of the town went to bed at sundown. One day a representative of the Standard Oil Company introduced a seven-cent lamp. A few people purchased them, largely out of curiosity. They were much pleased with the lamps, and news about them spread rapidly. As a result, within six months the Standard Oil Company sold over 7,000,000 of those lamps in China. The people who had heretofore gone to bed at dusk rather liked to stay up at night."

And, advertising will be a still bigger force. It is the only avenue that can be traversed by *Quick Improvement.* It will turn power plant customs and ideas into new channels.

Surely, it is better to take an interest in advertising and be in the procession, than not to be aware of one of the biggest forces which is shaping your life and career.